

MOFFAT

COLLECTION SYSTEM PROJECT
FINAL ENVIRONMENTAL IMPACT STATEMENT

Appendix I:

Air Quality Data



Appendix I: Air Quality Data



Appendix I

Air Quality Data

- Summary of Emissions:
 - By Project Alternative
 - For Alternative 1a (Proposed Action)
 - For Alternative 1c
 - For Alternative 8a
 - For Alternative 10a
 - For Alternative 13a
- Detailed Emissions Data:
 - Construction Duration
 - Construction Equipment Usage
 - Heavy Duty Construction Equipment Emission Factors
 - Additional Equipment Usage
 - Traffic Trips
 - Personnel
 - Exhaust Emissions from On-road Vehicles
 - Rock Crushing/Screening
 - Fugitive Dust Emissions
 - Additional Data

Appendix I

Air Quality Data

This page intentionally left blank

SUMMARY OF EMISSIONS

Summary of Emissions
Moffat Collection System Project

Total Emissions

Alternative	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
1a (Proposed Action)	494.36	423.44	315.79	79.37	12.04	60.06	0.07	0.18	0.32	0.40	0.07	1.04	26,606.32
1c	881.46	662.65	1,859.61	239.00	16.17	101.39	0.13	0.29	0.54	0.58	0.12	1.66	45,075.00
8a	562.09	440.64	641.26	108.01	12.14	65.91	0.09	0.20	0.39	0.42	0.08	1.18	28,182.46
10a	889.80	683.48	1,591.10	216.32	16.69	103.16	0.12	0.30	0.53	0.59	0.12	1.66	46,395.20
13a	602.38	475.74	705.86	118.65	12.87	70.79	0.11	0.22	0.40	0.46	0.08	1.27	30,674.88

Average Annual Emissions

Alternative	Average Annual Emissions (tons/year)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
1a (Proposed Action)	120.58	103.28	77.02	19.36	2.94	14.65	0.02	0.04	0.08	0.10	0.02	0.25	6,489.35
1c	265.58	201.58	539.30	70.30	4.99	30.67	0.04	0.09	0.16	0.18	0.04	0.50	13,641.84
8a	191.07	146.20	235.18	37.83	3.95	22.19	0.03	0.07	0.13	0.14	0.03	0.40	9,418.25
10a	322.15	243.33	564.44	76.08	5.77	37.09	0.04	0.11	0.19	0.21	0.04	0.59	16,703.35
13a	187.83	143.94	248.87	39.04	3.79	21.81	0.04	0.07	0.13	0.14	0.02	0.39	9,378.72

Summary of Emissions
Moffat Collection System Project

Alternative: 1a (Proposed Action) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]

Source	Total Emissions (tons)										GHGs CO ₂ e		
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	392.47	318.58	18.47	17.91	6.00	46.17	--	0.11	0.14	0.17	0.06	0.48	24,041.66
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	--	0.01	0.02	0.02	0.01	0.06	2,511.62
Onroad Exhaust													
Worker Commuting	59.22	4.38	0.11	--	0.04	4.53	0.04	0.02	0.09	0.07	--	0.22	42.60
Delivery Trucks	27.18	28.59	0.87	0.36	1.25	3.63	0.03	0.04	0.07	0.14	--	0.28	10.44
Fugitive Dust													
Wind Erosion	--	--	3.22	0.48	--	--	--	--	--	--	--	--	
Material Handling	--	--	--	--	--	--	--	--	--	--	--	--	
Paved Roads	--	--	156.36	22.58	--	--	--	--	--	--	--	--	
Unpaved Roads	--	--	105.98	10.59	--	--	--	--	--	--	--	--	
Rock Crushing/Screening	--	--	3.33	--	--	--	--	--	--	--	--	--	
Concrete Batching	--	--	22.35	22.35	--	--	--	--	--	--	--	--	
Total Alt. 1a (Proposed Action) Emissions (tons):	494.36	423.44	315.79	79.37	12.04	60.06	0.07	0.18	0.32	0.4	0.07	1.04	26,606.32
Project years:	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Avg. Alt. 1a (Proposed Action) Emissions (tons/year):	120.58	103.28	77.02	19.36	2.94	14.65	0.02	0.04	0.08	0.10	0.02	0.25	6,489.35

Summary of Emissions
Moffat Collection System Project

Alternative: 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Gross Reservoir

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	296.35	240.56	13.95	13.53	4.53	34.86	--	0.08	0.10	0.13	0.05	0.36	18,153.91
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	--	0.01	0.02	0.02	0.01	0.06	2,511.62
Onroad Exhaust													
Worker Commuting	44.72	3.31	0.08	--	0.03	3.42	0.03	0.02	0.07	0.05	--	0.17	32.16
Delivery Trucks	15.86	16.68	0.51	0.21	0.73	2.12	0.02	0.03	0.04	0.08	--	0.17	6.09
Fugitive Dust													
Wind Erosion	--	--	2.43	0.36	--	--	--	--	--	--	--	--	--
Material Handling	--	--	--	--	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	99.84	14.37	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	79.50	7.94	--	--	--	--	--	--	--	--	--
Rock Crushing/Screening	--	--	1.95	--	--	--	--	--	--	--	--	--	--
Concrete Batching	--	--	13.11	13.11	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	372.42	332.44	216.47	54.62	10.04	46.13	0.05	0.14	0.23	0.28	0.06	0.76	20,703.78
Project years:	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Avg. Emissions (tons/year):	120.14	107.24	69.83	17.62	3.24	14.88	0.02	0.05	0.07	0.09	0.02	0.25	6,678.64

Leyden Gulch Reservoir

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	396.53	321.88	18.66	18.10	6.06	46.65	--	0.11	0.14	0.17	0.06	0.48	24,290.29
Onroad Exhaust													
Worker Commuting	112.51	8.33	0.20	--	0.07	8.61	0.08	0.04	0.17	0.13	--	0.42	80.93
Delivery Trucks	--	--	--	--	--	--	--	--	--	--	--	--	--
Fugitive Dust													
Wind Erosion	--	--	2.76	0.41	--	--	--	--	--	--	--	--	--
Material Handling	--	--	0.29	0.04	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	95.28	13.24	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	1,525.95	152.59	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	509.04	330.21	1,643.14	184.38	6.13	55.26	0.08	0.15	0.31	0.30	0.06	0.90	24,371.22
Project years:	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Avg. Emissions (tons/year):	145.44	94.35	469.47	52.68	1.75	15.79	0.02	0.04	0.09	0.09	0.02	0.26	6,963.21
TOTAL ALT. 1c EMISSIONS (tons):	881.46	662.65	1,859.61	239.00	16.17	101.39	0.13	0.29	0.54	0.58	0.12	1.66	45,075.00
AVG. ALT. 1c EMISSIONS (tons/year):	265.58	201.58	539.30	70.30	4.99	30.67	0.04	0.09	0.16	0.18	0.04	0.50	13,641.84

Summary of Emissions
Moffat Collection System Project

**Alternative: 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Gross Reservoir**

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	304.36	247.07	14.32	13.89	4.65	35.81	--	0.09	0.11	0.13	0.05	0.38	18,644.55
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	--	0.01	0.02	0.02	0.01	0.06	2,511.62
Onroad Exhaust													
Worker Commuting	45.92	3.40	0.08	--	0.03	3.51	0.03	0.02	0.07	0.05	--	0.17	33.03
Delivery Trucks	20.12	21.17	0.64	0.26	0.93	2.69	0.02	0.03	0.05	0.10	--	0.20	7.73
Fugitive Dust													
Wind Erosion	--	--	2.50	0.37	--	--	--	--	--	--	--	--	--
Material Handling	--	--	--	--	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	117.51	16.96	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	84.78	8.47	--	--	--	--	--	--	--	--	--
Rock Crushing/Screening	--	--	2.44	--	--	--	--	--	--	--	--	--	--
Concrete Batching	--	--	16.38	16.38	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	385.89	343.53	243.75	61.43	10.36	47.74	0.05	0.15	0.25	0.30	0.06	0.81	21,196.93
Project years:	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Avg. Emissions (tons/year):	120.59	107.35	76.17	19.20	3.24	14.92	0.02	0.05	0.08	0.09	0.02	0.25	6,624.04

South Platte River Diversion, Gravel Pit Storage Pipeline & Conduit O

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	113.96	92.50	5.36	5.20	1.74	13.41	--	0.03	0.04	0.05	0.02	0.14	6,980.68
Onroad Exhaust													
Worker Commuting	62.24	4.61	0.11	--	0.04	4.76	0.04	0.02	0.10	0.07	--	0.23	4.85
Delivery Trucks	--	--	--	--	--	--	--	--	--	--	--	--	--
Fugitive Dust													
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	--	--
Material Handling	--	--	2.67	0.40	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	52.71	7.32	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	336.66	33.66	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	176.20	97.11	397.51	46.58	1.78	18.17	0.04	0.05	0.14	0.12	0.02	0.37	6,985.53
Project years:	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Avg. Emissions (tons/year):	70.48	38.84	159.00	18.63	0.71	7.27	0.02	0.02	0.06	0.05	0.01	0.15	2,794.21
TOTAL ALT. 8a EMISSIONS (tons):	562.09	440.64	641.26	108.01	12.14	65.91	0.09	0.20	0.39	0.42	0.08	1.18	28,182.46
AVG. ALT. 8a EMISSIONS (tons/year):	191.07	146.20	235.18	37.83	3.95	22.19	0.03	0.07	0.13	0.14	0.03	0.40	9,418.25

Summary of Emissions
Moffat Collection System Project

Alternative: 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Gross Reservoir

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	304.36	247.07	14.32	13.89	4.65	35.81	--	0.09	0.11	0.13	0.05	0.38	18,644.55
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	--	0.01	0.02	0.02	0.01	0.06	2,511.62
Onroad Exhaust													
Worker Commuting	45.92	3.40	0.08	--	0.03	3.51	0.03	0.02	0.07	0.05	--	0.17	33.03
Delivery Trucks	20.12	21.17	0.64	0.26	0.93	2.69	0.02	0.03	0.05	0.10	--	0.20	7.73
Fugitive Dust													
Wind Erosion	--	--	2.50	0.37	--	--	--	--	--	--	--	--	--
Material Handling	--	--	--	--	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	117.51	16.96	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	663.93	66.39	--	--	--	--	--	--	--	--	--
Rock Crushing/Screening	--	--	2.44	--	--	--	--	--	--	--	--	--	--
Concrete Batching	--	--	16.38	16.38	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	385.89	343.53	822.90	119.35	10.36	47.74	0.05	0.15	0.25	0.30	0.06	0.81	21,196.93
Project years:	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Avg. Emissions (tons/year):	120.59	107.35	257.16	37.30	3.24	14.92	0.02	0.05	0.08	0.09	0.02	0.25	6,624.04

Denver Basin ASR Pipeline & Conduit M

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	410.25	333.02	19.31	18.73	6.27	48.26	--	0.12	0.14	0.18	0.06	0.50	25,130.90
Onroad Exhaust													
Worker Commuting	93.66	6.93	0.17	--	0.06	7.16	0.07	0.03	0.14	0.11	--	0.35	67.37
Delivery Trucks	--	--	--	--	--	--	--	--	--	--	--	--	--
Fugitive Dust													
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	--	--
Material Handling	--	--	5.48	0.83	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	79.31	11.02	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	663.93	66.39	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	503.91	339.95	768.20	96.97	6.33	55.42	0.07	0.15	0.28	0.29	0.06	0.85	25,198.27
Project years:	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Avg. Emissions (tons/year):	201.56	135.98	307.28	38.79	2.53	22.17	0.03	0.06	0.11	0.12	0.02	0.34	10,079.31
TOTAL ALT. 10a EMISSIONS (tons):	889.80	683.48	1,591.10	216.32	16.69	103.16	0.12	0.30	0.53	0.59	0.12	1.66	46,395.20
AVG. ALT. 10a EMISSIONS (tons/year):	322.15	243.33	564.44	76.08	5.77	37.09	0.04	0.11	0.19	0.21	0.04	0.59	16,703.35

Summary of Emissions
Moffat Collection System Project

Alternative: 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
 Gross Reservoir

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	344.41	279.57	16.21	15.72	5.27	40.52	--	0.10	0.12	0.15	0.05	0.42	21,097.78
Portable Diesel Engine Exhaust	15.49	71.89	5.10	5.10	4.75	5.73	--	0.01	0.02	0.02	0.01	0.06	2,511.62
Onroad Exhaust													
Worker Commuting	51.97	3.85	0.09	--	0.03	3.98	0.04	0.02	0.08	0.06	--	0.20	37.38
Delivery Trucks	22.77	23.95	0.73	0.30	1.05	3.04	0.03	0.04	0.06	0.12	--	0.25	8.74
Fugitive Dust													
Wind Erosion	--	--	2.83	0.42	--	--	--	--	--	--	--	--	--
Material Handling	--	--	--	--	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	132.97	19.19	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	94.44	9.44	--	--	--	--	--	--	--	--	--
Rock Crushing/Screening	--	--	2.78	--	--	--	--	--	--	--	--	--	--
Concrete Batching	--	--	18.70	18.70	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	434.64	379.26	273.85	68.87	11.10	53.27	0.07	0.17	0.28	0.35	0.06	0.93	23,655.52
Project years:	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Avg. Emissions (tons/year):	120.73	105.35	76.07	19.13	3.08	14.80	0.02	0.05	0.08	0.10	0.02	0.26	6,570.98

South Platte River Diversion, Gravel Pit Storage Pipeline & Conduit O

Source	Total Emissions (tons)											GHGs CO ₂ e	
	Criteria Pollutants						HAPs						
	CO	NO _x	PM10	PM2.5	SO ₂	VOC	1, 3 Butadiene	Acetal-dehyde	Benzene	Formal-dehyde	Toluene	Total HAPs	
Construction Equipment Exhaust	113.96	92.50	5.36	5.20	1.74	13.41	--	0.03	0.04	0.05	0.02	0.14	6,980.68
Onroad Exhaust													
Worker Commuting	53.78	3.98	0.10	--	0.03	4.11	0.04	0.02	0.08	0.06	--	0.20	38.68
Delivery Trucks	--	--	--	--	--	--	--	--	--	--	--	--	--
Fugitive Dust													
Wind Erosion	--	--	--	--	--	--	--	--	--	--	--	--	--
Material Handling	--	--	3.03	0.46	--	--	--	--	--	--	--	--	--
Paved Roads	--	--	45.54	6.33	--	--	--	--	--	--	--	--	--
Unpaved Roads	--	--	377.98	37.79	--	--	--	--	--	--	--	--	--
Total Emissions (tons):	167.74	96.48	432.01	49.78	1.77	17.52	0.04	0.05	0.12	0.11	0.02	0.34	7,019.36
Project years:	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Avg. Emissions (tons/year):	67.10	38.59	172.80	19.91	0.71	7.01	0.02	0.02	0.05	0.04	0.01	0.14	2,807.74
TOTAL ALT. 13a EMISSIONS (tons):	602.38	475.74	705.86	118.65	12.87	70.79	0.11	0.22	0.40	0.46	0.08	1.27	30,674.88
AVG. ALT. 13a EMISSIONS (tons/year):	187.83	143.94	248.87	39.04	3.79	21.81	0.04	0.07	0.13	0.14	0.02	0.39	9,378.72

DETAILED EMISSIONS DATA

Construction Duration

Data: Construction Duration
Alternative: All
Project: Moffat Collection System Project

Alternative	Task	Construction Duration (months)	Days/Week	Hours/Day	Hours/Week	Hours per Month*
Proposed Action (1a)	Gross Reservoir	49	5	8	40	173
1c	Gross Reservoir	37	5	8	40	173
	Leyden Gulch Reservoir	42	5	8	40	173
8a	Gross Reservoir	38	5	8	40	173
	Gravel Pit Storage	30	5	8	40	173
	Conduit O	30	5	8	40	173
10a	Gross Reservoir	38	5	8	40	173
	ASR Wells	30	5	24	120	520
	Conduit M	30	5	8	40	173
13a	Gross Reservoir	43	5	8	40	173
	Gravel Pit Storage	30	5	8	40	173
	Conduit O	30	5	8	40	173

* Assumes 4.33 weeks per month.

Construction Equipment Usage

Data: Construction Equipment Usage
 Alternative: All
 Project: Moffat Collection System Project

Equipment Type	Horse-power (HP)	Proposed Action (Alternative 1a)		Alternative 1c				Alternative 8a							
		Gross Reservoir		Gross Reservoir		Leyden Gulch Reservoir		Total	Gross Reservoir		Gravel Pit Storage		Conduit O		Total
		Quantity	Equip.-Months	Quantity	Equip.-Months	Quantity	Equip.-Months	Equip.-Months	Quantity	Equip.-Months	Quantity	Equip.-Months	Quantity	Equip.-Months	Equip.-Months
Air Compressor	75	1	49	1	37	1	42	79	1	38	1	30	1	30	98
Backhoe	101	2	98	2	74	2	84	158	2	76	1	30	1	30	136
Compactor	232	2	98	2	74	2	84	158	2	76	1	30	1	30	136
Crane	275	0	0	0	0	0	0	0	0	0	1	30	1	30	60
Dozer	185	2	98	2	74	2	84	158	2	76	0	0	0	0	76
Dump Truck	250	8	392	8	296	4	168	464	8	304	0	0	0	0	304
Front End Loader	135	0	0	0	0	4	168	168	0	0	0	0	0	0	0
Fuel Truck	250	1	49	1	37	1	42	79	1	38	1	30	1	30	98
Generator, Diesel	50	2	98	2	74	2	84	158	2	76	1	30	1	30	136
Motor Grader	220	1	49	1	37	4	168	205	1	38	0	0	0	0	38
Pickup Truck	225	10	490	10	370	10	420	790	10	380	4	120	4	120	620
Pile Driver	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scraper	460	8	392	8	296	8	336	632	8	304	0	0	0	0	304
Water Truck	250	1	49	1	37	4	168	205	1	38	1	30	1	30	98
Welder	75	1	49	1	37	1	42	79	1	38	1	30	1	30	98
Tunnel Boring Machine	250	0	0	0	0	1	42	42	0	0	0	0	0	0	0
Well Drilling Rig	2100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		39	1911	39	1443	46	1932	3375	39	1482	12	360	12	360	2202

Equipment Type	Horse-power (HP)	Alternative 10a						Alternative 13a							
		Gross Reservoir		ASR		Conduit M		Total	Gross Reservoir		Gravel Pit Storage		Conduit O		Total
		Quantity	Equip.- Months	Quantity	Equip.- Months	Quantity	Equip.- Months	Equip.- Months	Quantity	Equip.- Months	Quantity	Equip.- Months	Quantity	Equip.- Months	Equip.- Months
Air Compressor	75	1	38	1	30	1	30	98	1	43	1	30	1	30	103
Backhoe	101	2	76	1	30	1	30	136	2	86	1	30	1	30	146
Compactor	232	2	76	1	30	1	30	136	2	86	1	30	1	30	146
Crane	275	0	0	1	30	1	30	60	0	0	1	30	1	30	60
Dozer	185	2	76	0	0	0	0	76	2	86	0	0	0	0	86
Dump Truck	250	8	304	1	30	0	0	334	8	344	0	0	0	0	344
Front End Loader	135	0	0	1	30	0	0	30	0	0	0	0	0	0	0
Fuel Truck	250	1	38	1	30	1	30	98	1	43	1	30	1	30	103
Generator, Diesel	50	2	76	1	30	1	30	136	2	86	1	30	1	30	146
Motor Grader	220	1	38	0	0	0	0	38	1	43	0	0	0	0	43
Pickup Truck	225	10	380	6	180	4	120	680	10	430	4	120	4	120	670
Pile Driver	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scraper	460	8	304	0	0	0	0	304	8	344	0	0	0	0	344
Water Truck	250	1	38	1	30	1	30	98	1	43	1	30	1	30	103
Welder	75	1	38	1	30	1	30	98	1	43	1	30	1	30	103
Tunnel Boring Machine	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Well Drilling Rig	2100	0	0	1	30	0	0	30	0	0	0	0	0	0	0
Total		39	1482	17	510	12	360	2352	39	1677	12	360	12	360	2397

Heavy Duty Construction Equipment Emission Factors

Data: Heavy Duty Construction Equipment Emission Factors
 Alternative: All
 Project: Moffat Collection System Project

Equipment Type	HP	Load Factor	Emission Factor (g/hp-hr) ²												Emissions (lb/hr)													
			CO	NOx	PM ₁₀ ³	PM _{2.5} ³	SO ₄ ⁴	VOC	Acetal-dehyde ⁵	Benzene ⁵	Formaldehyde ⁵	Toluene ⁵	CO ₂ ⁶	CH ₄ ⁷	N ₂ O ⁷	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetal-dehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O
Air Compressor	75	0.43	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00
Backhoe	101	0.21	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00
Compactor	232	0.43	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00
Crane	275	0.43	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00
Dozer	185	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00
Dump Truck	250	0.21	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00
Front End Loader	135	0.21	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.88E-04	2.34E-04	8.12E-05	32.18	0.00	0.00
Fuel Truck	250	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01
Generator, Diesel	50	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00
Motor Grader	220	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.43	1.97	0.11	0.11	0.04	0.29	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00
Pickup Truck	225	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00
Pile Driver	500	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01
Scraper	460	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01
Water Truck	250	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01
Welder	75	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00
Tunnel Boring Machine	250	0.59	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01
Well Drilling Rig	2,100	0.43	8.50	6.90	0.40	0.39	0.13	1.00	2.44E-03	2.96E-03	3.75E-03	1.30E-03	514.86	0.03	0.02	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03

1 Operating load factors taken from "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling," EPA-420-P-04-005, April 2004.

2 Emission factors are based on a mix of Tier 0, Tier 1, and Tier 2 equipment operating in the field. Therefore, Tier 1 emission factors are conservatively assumed for the life of the project.

3 The emission factor for total PM emissions is 0.4. For diesel combustion, the fraction assigned to PM_{2.5} is 0.97 ("Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling," EPA-420-P-04-005, April 2004, p.23).

4 SO₂ emissions are based on a sulfur balance and 350-ppm diesel.

5 EPA-42 Table 3.3-2 (1996).

6 Based on 10.15 kg CO₂/gal diesel. Table C.3 of California Climate Action Registry General Reporting Protocol (CCARP) (2009), available at http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf.

7 Based on: N₂O emissions of 0.082 g/L and CH₄ emissions of 0.14 g/L of diesel fuel. API Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-17 (2009).

Conversion Factors:

Diesel Btu/gal	138000	From 40 CFR Part 98, Subpart C, Table C-1
Btu/hp-hr, Brake-Specific Fuel Consumption	7000	AP-42 Table 3.3-1 (10/96)
liters/gal	3.785	
g/kg	1000	
g/lb	453.59	

Source: Exhaust Emissions from Heavy Duty Construction Equipment
Alternative: Proposed Action (Alternative 1a) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]
Project: Moffat Collection System Project

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hrs)	Emissions (lb/hr)										Total Emissions (tons)															
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO _{2,e} ¹		
Air Compressor	49.0	173.2	8486.8	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	2.56	2.08	0.12	0.04	0.30	7.35E-03	8.94E-04	1.13E-03	3.92E-04	157			
Backhoe	98.0	173.2	16973.6	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	3.37	2.74	0.16	0.05	0.40	9.66E-04	1.18E-03	1.49E-03	5.15E-04	206			
Compactor	98.0	173.2	16973.6	1.87	1.52	0.09	0.09	0.03	0.22	5.30E-04	6.52E-04	8.24E-04	2.96E-04	113.23	0.01	0.00	15.85	12.87	0.75	0.24	1.87	4.55E-03	5.53E-03	6.99E-03	2.42E-03	971			
Crane	0.0	173.2	0.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0		
Dozer	98.0	173.2	16973.6	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	17.35	14.08	0.82	0.27	2.04	4.97E-03	6.05E-03	7.65E-03	2.65E-03	1,063			
Dump Truck	392.0	173.2	67894.4	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	33.37	27.09	1.57	0.51	3.93	9.57E-03	1.16E-02	1.47E-02	5.10E-03	2,044			
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0		
Fuel Truck	49.0	173.2	8486.8	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-04	4.22E-04	167.42	0.01	0.01	11.72	9.51	0.55	0.53	0.53	0.53	0.18	1.38	3.36E-03	4.0E-03	5.17E-03	1.79E-03	718
Generator, Diesel	98.0	173.2	16973.6	0.55	0.45	0.05	0.03	0.01	0.05	1.58E-04	1.87E-04	2.44E-04	8.45E-05	1.00	0.00	0.00	4.69	3.31	0.24	0.21	0.07	0.54	1.34E-03	1.64E-03	2.07E-03	7.17E-04	287		
Motor Grader	49.0	173.2	8486.8	2.43	1.97	0.11	0.11	0.04	0.24	6.97E-04	8.46E-04	1.07E-04	3.40E-04	147.33	0.00	0.00	10.40	8.37	0.49	0.47	0.16	1.21E-03	1.53E-03	1.83E-03	2.23E-03	634			
Pile Driver	49.0	173.2	8486.8	2.09	1.62	0.12	0.11	0.04	0.29	7.11E-04	8.67E-04	1.11E-04	3.90E-04	150.68	0.01	0.00	105.49	85.62	4.96	4.81	1.61	12.41	3.02E-02	3.69E-02	4.66E-02	1.61E-02	4,462		
Pile Driver	0.0	173.2	0.0	1.52	1.48	0.26	0.25	0.08	0.65	1.98E-03	2.44E-03	3.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0			
Scraper	392.0	173.2	67894.4	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	172.52	140.04	8.12	7.87	2.64	20.30	4.95E-02	6.02E-02	7.61E-02	2.64E-02	10,568		
Water Truck	49.0	173.2	8486.8	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-04	4.22E-04	167.42	0.01	0.01	11.72	9.51	0.55	0.53	0.18	1.38	3.36E-03	4.0E-03	5.17E-03	1.79E-03	718		
Welder	49.0	173.2	8486.8	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	3.52	2.85	0.17	0.16	0.05	0.41	1.01E-03	1.23E-03	1.55E-03	5.38E-04	215		
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-04	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0		
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0		
				Total Emissions (tons)										392.47	318.58	18.47	17.91	6.00	46.17	0.11	0.14	0.17	0.06	24,041.66					

1 Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	49	49	49	49	49	49	49	49	49	49	49	49
Emissions (tons/month)	8.01	6.50	0.38	0.37	0.12	0.94	0.00	0.00	0.00	0.00	0.00	490.65

Source: Exhaust Emissions from Heavy Duty Construction Equipment
Alternative: Alternative 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Project: Moffat Collection System Project

Gross Reservoir

Equipment Type	Equipment Usage (months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)														
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂ e ¹	
				0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.93	1.57	0.09	0.09	0.03	2.3	5.55E-04	6.75E-04	8.54E-04	2.96E-04	111.00	
Air Compressor	37.0	173.2	6408.4	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.93	1.57	0.09	0.09	0.03	2.3	5.55E-04	6.75E-04	8.54E-04	2.96E-04	111.00	
Backhoe	74.0	173.2	12816.8	0.40	0.32	0.02	0.02	0.01	0.05	1.44E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	2.58	2.07	0.12	0.12	0.04	3.0	7.30E-04	8.89E-04	1.12E-03	3.89E-04	156.00	
Compactor	74.0	173.2	12816.8	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00	11.97	9.72	0.56	0.55	0.18	1.41	3.43E-03	4.18E-03	5.28E-03	1.83E-03	73.00	
Cross Driller	0.0	173.2	0.0	2.21	1.89	0.10	0.10	0.03	0.26	6.85E-04	7.72E-04	9.77E-04	3.39E-04	134.23	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dozer	74.0	173.2	12816.8	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	13.10	10.63	0.62	0.60	0.20	1.54	3.76E-03	4.57E-03	5.78E-03	2.00E-03	80.00	
Dump Truck	296.0	173.2	5126.7	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	25.20	20.46	1.19	1.15	0.39	2.96	7.23E-03	8.79E-03	1.11E-02	3.85E-03	154.00	
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fuel Truck	37.0	173.2	6408.4	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	8.85	7.18	0.42	0.40	0.14	1.04	2.54E-03	3.09E-03	3.90E-03	1.35E-03	54.00	
Generator, Diesel	74.0	173.2	12816.8	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	3.54	2.87	0.17	0.16	0.05	0.42	1.01E-03	1.23E-03	1.56E-03	5.41E-04	21.00	
Motor Grader	37.0	173.2	6408.4	2.43	1.97	0.11	0.11	0.04	0.29	6.37E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	7.73	6.32	0.37	0.36	0.12	0.92	2.23E-03	2.72E-03	3.44E-03	1.19E-03	47.00	
Pickup Truck	370.0	173.2	6408.4	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	79.65	64.66	3.75	3.64	1.22	9.37	2.28E-02	2.78E-02	3.51E-02	1.22E-02	48.70	
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper	296.0	173.2	5126.7	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	130.27	105.75	6.13	5.95	1.99	15.33	3.74E-02	4.54E-02	5.75E-02	1.99E-02	7.98.00	
Water Truck	37.0	173.2	6408.4	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.24E-04	167.42	0.01	0.01	8.85	7.18	0.42	0.40	0.14	1.04	2.54E-03	3.09E-03	3.90E-03	1.35E-03	54.00	
Welder	37.0	173.2	6408.4	0.83	0.67	0.04	0.04	0.01	0.10	2.30E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.65	2.16	0.12	0.12	0.04	0.31	7.61E-04	9.26E-04	1.17E-03	4.06E-04	16.00	
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.24E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions (tons)										296.35	240.56	13.95	13.53	4.53	34.86	0.08	0.10	0.13	0.05	18.153.9				

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	37	37	37	37	37	37	37	37	37	37	37
Emissions (tons/month)	8.01	6.50	0.38	0.37	0.12	0.94	0.00	0.00	0.00	0.00	490.63

Leyden Gulch Reservoir

Equipment Type	Equipment Usage (months)	Operating Activity (hours/month)	Total Time Operating (hrs)	Emissions (lb/hr)										Total Emissions (tons)													
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂ e ¹
Air Compressor	42.0	173.2	7274.4	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.60E-04	9.23E-05	36.61	0.00	0.00	2.20	1.78	0.10	0.10	0.03	2.65	6.30E-04	7.66E-04	9.69E-04	3.26E-04	13.1
Backhoe	82.0	173.2	14548.8	0.40	0.32	0.02	0.02	0.01	0.05	1.30E-04	1.75E-04	2.07E-04	6.07E-05	24.07	0.00	0.00	2.89	2.35	0.14	0.13	0.04	3.44	2.88E-04	3.10E-04	3.10E-04	4.24E-04	17.7
Compactor	84.0	173.2	14548.8	1.87	1.52	0.09	0.09	0.03	0.22	5.35E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00	13.59	11.03	0.64	0.62	0.21	1.60	3.90E-03	4.74E-03	5.95E-03	2.06E-03	83.3
Crane	0.0	173.2	0.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dozer	84.0	173.2	14548.8	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	14.87	12.07	0.70	0.68	0.23	1.75	4.26E-03	5.19E-03	6.56E-03	2.27E-03	23.3
Dump Truck	168.0	173.2	29097.6	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	14.30	11.61	0.67	0.65	0.22	1.68	4.10E-03	4.95E-03	6.31E-03	2.19E-03	87.0
Front End Loader	168.0	173.2	29097.6	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	7.72	6.27	0.36	0.35	0.12	0.91	2.21E-03	2.69E-03	3.41E-03	1.18E-03	23.3
Fuel Truck	42.0	173.2	7274.4	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	10.05	8.15	0.47	0.46	0.15	1.18	2.88E-03	3.50E-03	4.43E-03	1.54E-03	61.0
Generator, Diesel	84.0	173.2	14548.8	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	4.02	3.26	0.19	0.18	0.06	0.47	1.15E-03	1.40E-03	1.77E-03	4.14E-04	24.0
Motor Grader	168.0	173.2	29097.6	2.43	1.97	0.11	0.11	0.04	0.28	6.37E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	35.36	28.70	1.66	1.61	0.54	4.16	1.01E-02	1.23E-02	1.56E-02	5.41E-03	21.6
Pickup Truck	42.0	173.2	72744.0	2.49	2.02	0.12	0.11	0.04	0.28	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	90.41	73.39	4.25	4.13	1.38	10.64	2.59E-02	3.02E-02	3.39E-02	1.38E-02	55.3
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.63	1.58E-03	1.93E-03	2.44E-03	8.45E-04	33.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Scraper	336.0	173.2	58195.2	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	306.08	0.02	0.01	147.88	120.04	6.96	6.75	2.26	17.40	4.24E-02	5.16E-02	6.52E-02	2.22E-02	9.05
Water Truck	168.0	173.2	29097.6	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	40.18	32.62	1.89	1.83	0.61	4.73	1.15E-02	1.40E-02	1.77E-02	6.14E-03	24.6
Welder	42.0	173.2	7274.4	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	3.01	2.45	0.14	0.14	0.05	0.35	8.64E-04	1.05E-03	1.33E-03	4.14E-04	18.4
Tunnel Boring Machine	42.0	173.2	7274.4	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	10.05	8.15	0.47	0.46	0.15	1.18	2.88E-03	3.50E-03	4.43E-03	1.54E-03	61.0
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions (tons)										396.53	321.88	18.66	18.10	6.06	46.65	0.11	0.14	0.17	0.06	24.290.23			

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 319)

Task Duration (months)	42	42	42	42	42	42	42	42	42	42	42
Emissions (tons/month)	9.44	7.66	0.44	0.43	0.14	1.11	0.00	0.00	0.00	0.00	578.3

Denver Water Moffat Collection System
URS Project: 22241500

Equip. Exhaust Emissions 1c

Source: Exhaust Emissions from Heavy Duty Construction Equipment
Alternative: Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Project: Moffat Collection System Project

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	38	38	38	38	38	38	38	38	38	38	38
Emissions (tons/month)	8.01	6.50	0.38	0.37	0.12	0.94	0.00	0.00	0.00	0.00	490.60

Gravel Pit Storage

Equipment Type	Equipment Usage (months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)												
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene
Air Compressor	30.0	173.2	5196.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.57	1.27	0.07	0.07	0.02	0.18	4.50E-04	5.47E-04	6.92E-04	2.40E-04
Backhoe	30.0	173.2	5196.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	1.03	0.84	0.05	0.05	0.02	0.12	2.96E-04	3.60E-04	4.55E-04	1.58E-04
Compactor	30.0	173.2	5196.0	0.50	0.38	0.03	0.03	0.02	0.05	5.38E-04	6.52E-04	8.03E-04	2.86E-04	113.23	0.00	0.00	4.85	3.94	0.24	0.24	0.03	0.17	1.68E-04	2.05E-04	2.51E-04	1.08E-04
Dane	30.0	173.2	5196.0	2.21	1.80	0.10	0.10	0.04	0.28	1.77E-04	2.04E-04	1.03E-04	1.03E-04	100.00	0.01	0.01	5.43	4.67	0.27	0.26	0.09	0.17	1.65E-03	1.91E-03	2.54E-03	8.80E-04
Dozer	0.0	173.2	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump Truck	0.0	173.2	0.0	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fuel Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.18	2.06E-03	2.50E-03	3.17E-03	1.10E-03
Generator, Diesel	30.0	173.2	5196.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	1.44	1.16	0.07	0.07	0.02	0.17	4.11E-04	5.01E-04	6.33E-04	2.19E-04
Motor Grader	0.0	173.2	0.0	2.43	1.97	0.11	0.11	0.04	0.29	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pickup Truck	120.0	173.2	20784.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	25.83	20.97	1.22	1.18	0.40	3.04	7.41E-03	9.01E-03	1.14E-02	3.95E-03
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.03E-03	1.93E-03	2.44E-03	4.85E-04	33.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper	0.0	173.2	0.0	5.58	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	3.77E-04	36.08	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Snow Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.17	4.11E-03	5.01E-03	6.33E-03	2.19E-03
Welder	30.0	173.2	5196.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.15	1.75	0.10	0.10	0.03	0.25	1.67E-04	2.75E-04	4.95E-04	3.29E-04
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions (ton/h)										56.98	46.25	2.68	2.60	0.87	6.70	0.02	0.02	0.03	0.01	3.490E-03		

1 Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	1.90	1.54	0.09	0.09	0.03	0.22	0.00	0.00	0.00	0.00	116.3

Denver Water Moffat Collection System
URS Project: 22241500

Equip. Exhaust Emissions 8a

Source: Exhaust Emissions from Heavy Duty Construction Equipment
Alternative: Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Project: Moffat Collection System Project

Conduit O

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)														
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂ e ¹	
Air Compressor	30.0	173.2	5196.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.57	1.27	0.07	0.07	0.02	0.18	4.50E-04	5.47E-04	6.92E-04	2.40E-04	96	
Backhoe	30.0	173.2	5196.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	1.03	0.84	0.05	0.05	0.02	0.12	2.96E-04	3.60E-04	4.55E-04	1.58E-04	63	
Compactor	30.0	173.2	5196.0	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00	4.85	3.94	0.23	0.22	0.07	0.57	1.39E-03	1.69E-03	2.14E-03	7.42E-04	297	
Crane	30.0	173.2	5196.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	5.75	4.67	0.27	0.26	0.09	0.68	1.65E-03	2.01E-03	2.54E-03	8.80E-04	352	
Dozer	0.0	173.2	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Dump Truck	0.0	173.2	0.0	0.98	0.80	0.05	0.04	0.00	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Front End Loader	0.0	173.2	0.0	0.53	0.42	0.02	0.01	0.01	0.20	1.03E-04	1.25E-04	1.45E-04	4.12E-04	12.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Flat Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.03E-03	2.50E-03	3.17E-03	1.10E-03	440	
Generator, Diesel	30.0	173.2	5196.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	1.44	1.16	0.07	0.07	0.02	0.17	4.11E-04	5.01E-04	6.33E-04	2.19E-04	88	
Motor Grader	0.0	173.2	0.0	2.43	1.97	0.11	0.11	0.04	0.29	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Pickup Truck	120.0	173.2	20784.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	25.83	20.37	1.22	1.18	0.40	3.04	7.41E-03	9.01E-03	1.14E-02	3.95E-03	1,582	
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Scrapie	0.0	173.2	0.0	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Water Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03	440	
Welder	30.0	173.2	5196.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.15	1.75	0.10	0.10	0.03	0.25	6.17E-04	7.51E-04	9.50E-04	3.29E-04	132	
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
				Total Emissions (tons)										56.98	46.25	2.68	2.60	0.87	6.70	0.02	0.02	0.03	0.01	3,490.34				

1 Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	1.90	1.54	0.09	0.09	0.03	0.22	0.00	0.00	0.00	0.00	0.00	0.00

Total Alt. 8a Emissions (tons/month)	11.81	9.59	0.56	0.54	0.18	1.39	0.00	0.00	0.01	0.00	723.34
--------------------------------------	-------	------	------	------	------	------	------	------	------	------	--------

Source: Exhaust Emissions from Heavy Duty Construction Equipment

Alternative: Alternative 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells

Project: Moffat Collection System Project

Gross Reservoir

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	38	38	38	38	38	38	38	38	38	38	38
Emissions (tons/month)	8.01	6.50	0.38	0.37	0.12	0.94	0.00	0.00	0.00	0.00	490.65

ASR Wells

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)												Total Emissions (tons)												
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂ e ¹	
Air Compressor	30.0	519.6	15588.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	4.71	3.82	0.22	0.21	0.07	0.55	1.35E-03	1.64E-03	2.08E-03	7.20E-04	288.0	
Backhoe	30.0	519.6	15588.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	3.10	2.51	0.15	0.14	0.05	0.36	8.88E-04	1.08E-03	1.37E-03	4.73E-03	190.0	
Compactor	30.0	519.6	15588.0	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	112.33	0.01	0.00	14.56	11.82	0.69	0.66	0.22	1.71	4.17E-03	5.08E-03	6.42E-03	2.23E-03	892.0	
Crane	30.0	519.6	15588.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	17.26	14.01	0.81	0.79	0.26	2.03	4.95E-03	6.02E-03	7.61E-03	2.64E-03	1,057.0	
Dozer	0.0	519.6	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dump Truck	30.0	519.6	15588.0	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	7.66	6.22	0.36	0.35	0.12	0.90	2.20E-03	2.67E-03	3.38E-03	1.17E-03	469.0	
Front End Loader	30.0	519.6	15588.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	4.14	3.36	0.19	0.19	0.06	0.49	1.19E-03	1.44E-03	1.83E-03	6.33E-04	252.0	
Fuel Truck	30.0	519.6	15588.0	2.76	2.24	0.13	0.13	0.04	0.32	7.32E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	21.53	17.47	1.01	0.98	0.33	2.53	6.17E-03	7.51E-03	9.50E-03	3.29E-03	1,319.0	
Generator, Diesel	30.0	519.6	15588.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.48E-05	33.48	0.00	0.00	4.31	3.49	0.20	0.20	0.07	0.51	1.23E-03	1.50E-03	1.90E-03	6.58E-04	264.0	
Motor Grader	0.0	519.6	0.0	2.43	1.97	0.11	0.11	0.04	0.29	6.07E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Pickup Truck	180.0	519.6	93528.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.04E-03	3.80E-04	150.69	0.01	0.00	16.25	14.36	5.47	5.31	1.78	13.68	3.33E-02	4.05E-02	5.13E-02	1.78E-02	7,121.0	
Pile Driver	0.0	519.6	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	6.84E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Scraper	0.0	519.6	0.0	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Water Truck	30.0	519.6	15588.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	21.53	17.47	1.01	0.98	0.33	2.53	6.17E-03	7.51E-03	9.50E-03	3.29E-03	1,319.0	
Welder	30.0	519.6	15588.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	6.46	5.24	0.30	0.29	0.10	0.76	1.85E-03	2.25E-03	2.85E-03	9.87E-04	396.0	
Tunnel Boring Machine	0.0	519.6	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Well Drilling Rig	30.0	519.6	15588.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	131.79	109.68	6.20	6.02	2.02	15.50	3.78E-02	4.60E-02	5.81E-02	2.01E-02	8,073.0	
				Total Emissions (tons)												353.27	286.77	16.62	16.13	5.40	41.56	0.10	0.12	0.16	0.05	21,640.55		

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	11.78	9.56	0.55	0.54	0.18	1.39	0.00	0.00	0.01	0.00	721.35

Denver Water Moffat Collection System

URS Project: 22241500

Equip. Exhaust Emissions 10a

Source: Exhaust Emissions from Heavy Duty Construction Equipment
Alternative: Alternative 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Project: Moffat Collection System Project

Conduit M

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)													
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO _{2e} ¹
Air Compressor	30.0	173.2	5196.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.57	1.27	0.07	0.02	0.18	4.50E-04	5.47E-04	6.92E-04	2.40E-04	96	
Backhoe	30.0	173.2	5196.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	1.03	0.84	0.05	0.05	0.12	2.96E-04	3.60E-04	4.55E-04	1.58E-04	63	
Compactor	30.0	173.2	5196.0	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00	4.85	3.94	0.23	0.22	0.07	0.57	1.39E-03	1.69E-03	2.14E-03	7.42E-04	297
Crane	30.0	173.2	5196.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	5.75	4.67	0.27	0.26	0.09	0.68	1.65E-03	2.01E-03	2.54E-03	8.80E-04	352
Dozer	0.0	173.2	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Dump Truck	0.0	173.2	0.0	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Fuel Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03	440
Generator, Diesel	30.0	173.2	5196.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	1.44	1.16	0.07	0.07	0.02	0.17	4.11E-04	5.01E-04	6.33E-04	2.19E-04	88
Motor Grader	0.0	173.2	0.0	2.43	1.97	0.11	0.11	0.04	0.29	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Pickup Truck	120.0	173.2	20784.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	28.83	20.97	1.22	1.18	0.40	3.04	7.41E-03	9.01E-03	1.14E-02	3.95E-03	1,582
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Scraper	0.0	173.2	0.0	5.08	4.13	0.24	0.23	0.05	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Water Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03	440
Welder	30.0	173.2	5196.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.15	1.75	0.10	0.10	0.03	0.25	6.17E-04	7.51E-04	9.50E-04	3.29E-04	132
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	1.90	1.54	0.09	0.09	0.03	0.22	0.00	0.00	0.00	0.00
Total	59.88	46.25	2.68	2.60	0.87	6.70	0.02	0.02	0.03	0.01

Total Alt. 10a Emissions (tons/month)	21.68	17.60	1.02	0.99	0.33	2.55	0.01	0.01	0.01	0.00	1328.34
---------------------------------------	-------	-------	------	------	------	------	------	------	------	------	---------

Source: Exhaust Emissions from Heavy Duty Construction Equipment

Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers

Project: Moffat Collection System Project

Gross Reservoir

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	43	43	43	43	43	43	43	43	43	43	43
Emissions (tons/month)	8.01	6.50	0.38	0.37	0.12	0.94	0.00	0.00	0.00	0.00	490.6

Gravel Pit Storage

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)														
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	
Air Compressor	30.0	173.2	5196.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	6.28E-04	9.23E-05	36.61	0.00	0.00	1.57	1.27	0.07	0.07	0.02	0.18	4.50E-04	5.47E-04	6.29E-04	2.40E-04		
Backhoe	30.0	173.2	5196.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	4.05E-04	6.07E-05	24.07	0.00	0.00	1.03	0.84	0.05	0.05	0.02	0.12	3.96E-04	3.65E-04	4.55E-04	1.54E-04		
Compactor	30.0	173.2	5196.0	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.62E-04	8.23E-04	2.86E-04	113.23	0.01	0.00	4.86	3.04	0.23	0.22	0.07	0.57	1.30E-03	1.68E-03	2.14E-03	7.42E-04		
Crawler	30.0	173.2	5196.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.73E-04	9.77E-04	3.39E-04	124.22	0.01	0.00	5.76	4.57	0.27	0.26	0.09	0.68	1.68E-03	2.01E-03	2.84E-03	8.80E-04		
Dozer	0.0	173.2	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Dump Truck	0.0	173.2	0.0	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Fuel Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03		
Generator, Diesel	30.0	173.2	5196.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	1.44	1.16	0.07	0.07	0.02	1.47	4.11E-04	5.01E-04	6.33E-04	2.19E-04		
Motor Grader	0.0	173.2	0.0	2.43	1.97	0.11	0.11	0.04	0.28	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Pickup Truck	120.0	173.2	20784.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	25.83	20.97	1.22	1.18	0.40	3.04	7.41E-03	1.01E-03	1.14E-02	3.95E-03		
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Scraper	0.0	173.2	0.0	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.77E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Water Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03		
Welder	30.0	173.2	5196.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.15	1.75	0.10	0.10	0.03	0.25	1.67E-04	7.51E-04	9.50E-04	3.29E-04		
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
				Total Emissions (ton)										56.98	46.25	2.68	2.60	0.87	6.70	0.02	0.02	0.03	0.01	3.4903				

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	1.90	1.54	0.09	0.09	0.03	0.22	0.00	0.00	0.00	0.00	116.33

Source: Exhaust Emissions from Heavy Duty Construction Equipment
 Alternative: Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
 Project: Moffat Collection System Project

Conduit O

Equipment Type	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)												Total Emissions (tons)											
				CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂ ¹
Air Compressor	30.0	173.2	5196.0	0.60	0.49	0.03	0.03	0.01	0.07	1.73E-04	2.11E-04	2.66E-04	9.23E-05	36.61	0.00	0.00	1.57	1.27	0.07	0.07	0.18	4.50E-04	5.47E-04	6.92E-04	2.40E-04	96	
Backhoe	30.0	173.2	5196.0	0.40	0.32	0.02	0.02	0.01	0.05	1.14E-04	1.39E-04	1.75E-04	6.07E-05	24.07	0.00	0.00	1.03	0.84	0.05	0.05	0.12	2.96E-04	3.60E-04	4.55E-04	1.58E-04	63	
Compactor	30.0	173.2	5196.0	1.87	1.52	0.09	0.09	0.03	0.22	5.36E-04	6.52E-04	8.24E-04	2.86E-04	113.23	0.01	0.00	4.85	3.94	0.23	0.22	0.07	0.57	1.39E-03	1.69E-03	2.14E-03	7.42E-04	297
Crane	30.0	173.2	5196.0	2.21	1.80	0.10	0.10	0.03	0.26	6.35E-04	7.72E-04	9.77E-04	3.39E-04	134.22	0.01	0.00	5.75	4.67	0.27	0.26	0.09	0.68	1.65E-03	2.01E-03	2.54E-03	8.80E-04	352
Dozer	0.0	173.2	0.0	2.04	1.66	0.10	0.09	0.03	0.24	5.86E-04	7.13E-04	9.02E-04	3.12E-04	123.89	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Dump Truck	0.0	173.2	0.0	0.98	0.80	0.05	0.04	0.02	0.12	2.82E-04	3.43E-04	4.34E-04	1.50E-04	59.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Front End Loader	0.0	173.2	0.0	0.53	0.43	0.02	0.02	0.01	0.06	1.52E-04	1.85E-04	2.34E-04	8.12E-05	32.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Fuel Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03	440
Generator, Diesel	30.0	173.2	5196.0	0.55	0.45	0.03	0.03	0.01	0.06	1.58E-04	1.93E-04	2.44E-04	8.45E-05	33.48	0.00	0.00	1.44	1.16	0.07	0.07	0.02	0.17	4.11E-04	5.01E-04	6.33E-04	2.19E-04	86
Motor Grader	0.0	173.2	0.0	2.43	1.97	0.11	0.11	0.04	0.29	6.97E-04	8.48E-04	1.07E-03	3.72E-04	147.33	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Pickup Truck	120.0	173.2	20784.0	2.49	2.02	0.12	0.11	0.04	0.29	7.13E-04	8.67E-04	1.10E-03	3.80E-04	150.68	0.01	0.00	25.83	20.97	1.22	1.18	0.40	3.04	7.41E-03	9.01E-03	1.14E-02	3.95E-03	1,582
Pile Driver	0.0	173.2	0.0	5.52	4.48	0.26	0.25	0.08	0.65	1.58E-03	1.93E-03	2.44E-03	8.45E-04	334.84	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Scraper	0.0	173.2	0.0	5.08	4.13	0.24	0.23	0.08	0.60	1.46E-03	1.74E-03	2.24E-03	7.77E-04	308.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Water Truck	30.0	173.2	5196.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	7.18	5.82	0.34	0.33	0.11	0.84	2.06E-03	2.50E-03	3.17E-03	1.10E-03	440
Welder	30.0	173.2	5196.0	0.83	0.67	0.04	0.04	0.01	0.10	2.38E-04	2.89E-04	3.66E-04	1.27E-04	50.23	0.00	0.00	2.15	1.75	0.10	0.10	0.03	0.25	6.17E-04	7.51E-04	9.50E-04	3.29E-04	132
Tunnel Boring Machine	0.0	173.2	0.0	2.76	2.24	0.13	0.13	0.04	0.32	7.92E-04	9.63E-04	1.22E-03	4.22E-04	167.42	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
Well Drilling Rig	0.0	173.2	0.0	16.91	13.73	0.80	0.77	0.26	1.99	4.85E-03	5.90E-03	7.46E-03	2.59E-03	1024.97	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	

1 Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1, (CO₂ = 1; CH₄ = 21; N₂O = 310)

Task Duration (months)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Emissions (tons/month)	1.90	1.54	0.09	0.09	0.03	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	116.34

Total Alt. 13a Emissions (tons/month)	11.81	9.59	0.56	0.54	0.18	1.39	0.00	0.00	0.01	0.00	723.34
---------------------------------------	-------	------	------	------	------	------	------	------	------	------	--------

Additional Equipment Usage

Additional Equipment Usage

Equipment Type	Months ¹	Days/ Week	Hours/ Day ²	Hours/ Week	Hours per Month ³
Diesel Engines for rock crushing/screening	24	5	11.2	56	242
Diesel Engines for concrete	15	5	24	120	520

Equipment Type	Horse- power (HP)	All Alternatives	
		Gross Reservoir	
		Quantity	Equip.- Months
Diesel Engines for rock crushing/screening	150	7	168
Diesel Engines for concrete	100	6	90
Total		13	258

1. Rock crushing/screening will occur for 8 months per year for 3 years. Concrete production will occur for 5 months per year for 3 years.
2. Rock crushing/screening is assumed to operate 24 hr/day 20% of the time and 8 hr/day 80% of the time.
Concrete production is assumed to operate 24 hr/day.
3. Assumes 4.33 weeks per month.

Source: Additional Equipment Emission Factors
 Task: All
 Alternative: All

Equipment Type	HP	Load Factor ¹	Emission Factor (lb/hp-hr) ²										Emissions (lb/hr)															
			CO	NOx	PM ₁₀	PM _{2.5} ³	SO ₂ ⁴	VOC ⁵	Acetaldehyde ⁶	Benzene ⁶	Formaldehyde ⁶	Toluene ⁶	CO ₂ ⁷	CH ₄ ⁸	N ₂ O ⁸	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O
Diesel Engines for rock crushing/screening	150	0.43	0.007	0.031	0.002	0.002	0.002	5.37E-06	6.53E-06	8.26E-06	2.86E-06	1.14E+00	5.93E-05	3.47E-05	0.43	2.00	0.14	0.14	0.13	0.16	3.46E-04	4.21E-04	5.33E-04	1.85E-04	73.21	0.00	0.00	
Diesel Engines for concrete	100	0.43	0.007	0.031	0.002	0.002	0.002	0.002	5.37E-06	6.53E-06	8.26E-06	2.86E-06	1.14E+00	5.93E-05	3.47E-05	0.29	1.33	0.09	0.09	0.09	0.11	2.31E-04	2.81E-04	3.55E-04	1.23E-04	48.81	0.00	0.00

1 Operating load factors taken from "Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling," EPA-420-P-04-005, April 2004.

2 Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources," EPA AP-42 Chapter 3, October 1996.

3 PM_{2.5} emissions are assumed to account for all PM10 emissions.

4 Emission factors for SO₂.

5 Emission factors for TOC. TOC emission factors are based solely on the exhaust component. Crankcase emission factors were not used.

6 EPA AP-42 Table 5.3-2 (1996).

7 Based on 10.15 kg CO₂/gal diesel. Table C.3 of California Climate Action Registry General Reporting Protocol (CARP) (2009), available at http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf.

8 Based on: N₂O emissions of 0.082 g/L and CH₄ emissions of 0.14 g/L of diesel fuel. API Compendium of GHG Emission Methodologies for the Oil and Gas Industry, Table 4-17 (2009).

Conversion Factors:

Diesel Btu/gal	138000	From 40 CFR Part 98, Subpart C, Table C-1
Btuh·hp-hr, Brake-Specific Fuel Consumption	7000	AP-42 Table 3.3-1 (10/96)
liters/gal	3.785	
g/kg	1000	
g/lb	453.59	

Source: Exhaust Emissions from Additional Equipment
 Alternative: All
 Project: Moffat Collection System Project

Equipment Type	Years	Equipment Usage (equipment months)	Operating Activity (hr/month)	Total Time Operating (hr)	Emissions (lb/hr)										Total Emissions (tons)													
					CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetal-dehyde	Benzene	Formaldehyde	Toluene	CO ₂	CH ₄	N ₂ O	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetal-dehyde	Benzene	Formaldehyde	Toluene	CO ₂ e ¹
Diesel Engines for rock crushing/screening	3	168.0	242.5	40736.6	0.43	2.00	0.14	0.14	0.13	0.16	3.46E-04	4.21E-04	5.33E-04	1.85E-04	73.21	0.00	0.00	8.78	40.73	2.89	2.89	2.69	3.24	0.01	0.01	0.01	0.00	1,506.97
Diesel Engines for concrete	3	90.0	519.6	46764.0	0.29	1.33	0.09	0.09	0.09	0.11	2.31E-04	2.81E-04	3.55E-04	1.23E-04	48.81	0.00	0.00	6.72	31.17	2.21	2.21	2.06	2.48	0.01	0.01	0.01	0.00	1,004.65
															Total Emissions		15.49	71.89	5.10	5.10	4.75	5.73	0.01	0.02	0.02	0.01	2,511.62	

¹ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Total Emissions (tons/year)										CO ₂ e
CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetal-dehyde	Benzene	Formaldehyde	Toluene	CO ₂ e
2.93	13.58	0.96	0.96	0.90	1.08	0.00	0.00	0.00	0.00	502.32
2.24	10.39	0.74	0.74	0.69	0.83	0.00	0.00	0.00	0.00	334.88
5.16	23.96	1.70	1.70	1.58	1.91	0.00	0.01	0.01	0.00	837.21

Traffic Trips

Data:

Alternative:

Project:

Traffic Trips

All

Moffat Collection System Project

Construction Schedule	Roundtrip Distance (mi)	Trips Per Day for Alternatives				
		1a (Proposed Action)	1c	8a	10a	13a
Daily Averages						
Gross Reservoir Haul and Concrete Trucks	96	22	17	21	21	21
Commuting Worker Vehicles	60	60	193	163	215	149
Peak						
Gross Reservoir Haul and Concrete Trucks	96	37	28	35	35	34
Commuting Worker Vehicles	60	101	319	279	359	231

Haul trucks operate 260 days/yr for Gross Reservoir. The roundtrip distance for Gross Reservoir is 96 miles.

Leyden Gulch Reservoir requires no offsite fill hauling.

Personnel

Data: Construction Manpower
Alternative: All
Project: Moffat Collection System Project

Construction Schedule	Number of Workers				
	1a (Proposed Action)	1c	8a	10a	13a
Year 1					
1st Qtr	16	50	60	66	44
2nd Qtr	32	113	109	140	84
3rd Qtr	47	163	156	200	116
4th Qtr	60	214	248	286	150
Year 2					
1st Qtr	91	325	343	415	223
2nd Qtr	121	438	382	490	298
3rd Qtr	132	475	418	538	322
4th Qtr	142	478	418	538	346
Year 3					
1st Qtr	151	478	367	524	346
2nd Qtr	151	445	283	361	346
3rd Qtr	146	364	217	328	284
4th Qtr	121	282	154	251	223
Year 4					
1st Qtr	95	251	109	176	174
2nd Qtr	73	134	101	122	125
3rd Qtr	53	104	NA	NA	104
4th Qtr	44	NA	NA	NA	84
Year 5					
1st Qtr	43	NA	NA	NA	NA
Daily Average	90	290	244	322	223
Quarterly Peak	151	478	418	538	686

Assume 1.5 workers per vehicle.

Exhaust Emissions from On-road Vehicles

Source: Exhaust Emissions from Onroad Vehicles
 Alternative: Proposed Action (Alternative 1a) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]
 Project: Moffat Collection System Project

Estimated Emissions from Construction Worker Vehicles (Personal)

Emission Factors (g/mile) ²											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
14.067	1.041	0.025	0.009	1.076	0.010	0.005	0.022	0.016	1.096	8.15E-05	0.029

Site	Trips per Day	Months	Years	Total Work Days ¹	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)									
							CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e ⁴
Gross Reservoir	60	49	4.08	1060.85	60	3,819,060	59.22	4.38	0.11	0.04	4.53	0.04	0.02	0.09	0.07	42.60

Total Emissions (tons/year)											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e		
14.502	1.073	0.026	0.009	1.109	0.010	0.005	0.022	0.017	10.432		

Exhaust Emissions from Delivery Trucks

Emission Factors (g/mile) ³											
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	N ₂ O
10.996	11.568	0.352	0.144	0.507	1.469	0.013	0.018	0.029	0.057	2.732	1.26E-04

Site	Truck Type	Trips per Day	Years	Hauling Days per Year	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)										
							CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
Gross Reservoir	Haul and Concrete Trucks	22	4.08	260	96	2,242,240	27.18	28.59	0.87	0.36	1.25	3.63	0.03	0.04	0.07	0.14	10.44

Total Emissions (tons/year)											
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e	
6.66	7.00	0.21	0.09	0.31	0.89	0.008	0.011	0.018	0.034	2.556	

¹ Assumes 21.65 work days per month.

² Composite emission factors from APCD for 2007 (e-mail from Dale Wells, APCD 4/20/07).

³ Assumes average vehicle weight of 60,000 lbs and is based on emission factors from APCD for 2008 (e-mail from Dale Wells, APCD 5/22/07). Emission factors would decline over the life of the project.

⁴ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Source: Exhaust Emissions from Onroad Vehicles
Alternative: Alternative 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Project: Moffat Collection System Project

Estimated Emissions from Construction Worker Vehicles (Personal)

Emission Factors (g/mile) ²											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
14.067	1.041	0.025	0.009	1.076	0.010	0.005	0.022	0.016	1.096	8.15E-05	0.029

Site	Trips per Day	Months	Years	Total Work Days ¹	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)									
							CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e ⁴
Gross Reservoir	60	37	3.08	801.05	60	2,883,780	44.72	3.31	0.08	0.03	3.42	0.03	0.02	0.07	0.05	32.16
Leyden Gulch Reservoir	133	42	3.50	909.3	60	7,256,214	112.51	8.33	0.20	0.07	8.61	0.08	0.04	0.17	0.13	80.93

Total Emissions (tons/year)										
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e	
14.502	1.073	0.026	0.009	1.109	0.010	0.005	0.022	0.017	10.432	
32.147	2.379	0.057	0.021	2.459	0.023	0.012	0.049	0.037	23.123	

Exhaust Emissions from Delivery Trucks

Emission Factors (g/mile) ³												
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
10.996	11.568	0.352	0.144	0.507	1.469	0.013	0.018	0.029	0.057	2.732	1.26E-04	0.005

Site	Truck Type	Trips per Day	Years	Hauling Days per Year	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)										
							CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
Gross Reservoir	Haul and Concrete Trucks	17	3.08	260	96	1,308,320	15.86	16.68	0.51	0.21	0.73	2.12	0.02	0.03	0.04	0.08	6.09

Total Emissions (tons/year)										
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
5.14	5.41	0.16	0.07	0.24	0.69	0.01	0.01	0.01	0.03	1.98

¹ Assumes 21.65 work days per month.

² Composite emission factors from APCD for 2007 (e-mail from Dale Wells, APCD 4/20/07).

³ Assumes average vehicle weight of 60,000 lbs and is based on emission factors from APCD for 2008 (e-mail from Dale Wells, APCD 5/22/07). Emission factors would decline over the life of the project.

⁴ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Source: Exhaust Emissions from Onroad Vehicles
Alternative: Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Project: Moffat Collection System Project

Estimated Emissions from Construction Worker Vehicles (Personal)

Emission Factors (g/mile) ²											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
14.067	1.041	0.025	0.009	1.076	0.010	0.005	0.022	0.016	1.096	8.15E-05	0.029

Site	Trips per Day	Months	Years	Total Work Days ¹	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)									
							CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e ⁴
Gross Reservoir	60	38	3.17	822.7	60	2,961,720	45.92	3.40	0.08	0.03	3.51	0.03	0.02	0.07	0.05	33.03
Gravel Pit Storage & Conduit O	103	30	2.50	649.5	60	4,013,910	62.24	4.61	0.11	0.04	4.76	0.04	0.02	0.10	0.07	4.85

Total Emissions (tons/year)											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e		
14.502	1.073	0.026	0.009	1.109	0.010	0.005	0.022	0.017	10.432		
24.896	1.842	0.044	0.016	1.904	0.018	0.009	0.038	0.029	1.939		

Exhaust Emissions from Delivery Trucks

Emission Factors (g/mile) ³												
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
10.996	11.568	0.352	0.144	0.507	1.469	0.013	0.018	0.029	0.057	2.732	1.26E-04	0.005

Site	Truck Type	Trips per Day	Years	Hauling Days per Year	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)										
							CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
Gross Reservoir	Haul and Concrete Trucks	21	3.17	260	96	1,659,840	20.12	21.17	0.64	0.26	0.93	2.69	0.02	0.03	0.05	0.10	7.73

Total Emissions (tons/year)											
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e	
6.35	6.68	0.20	0.08	0.29	0.85	0.01	0.01	0.02	0.03	0.02	0.03

¹ Assumes 21.65 work days per month.

² Composite emission factors from APCD for 2007 (e-mail from Dale Wells, APCD 4/20/07).

³ Assumes average vehicle weight of 60,000 lbs and is based on emission factors from APCD for 2008 (e-mail from Dale Wells, APCD 5/22/07). Emission factors would decline over the life of the project.

⁴ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Source: Exhaust Emissions from Onroad Vehicles
Alternative: Alternative 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Project: Moffat Collection System Project

Estimated Emissions from Construction Worker Vehicles (Personal)

Emission Factors (g/mile) ²											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
14.067	1.041	0.025	0.009	1.076	0.010	0.005	0.022	0.016	1.096	8.15E-05	0.029

Site	Trips per Day	Months	Years	Total Work Days ¹	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)									
							CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e ⁴
Gross Reservoir	60	38	3.17	822.7	60	2,961,720	45.92	3.40	0.08	0.03	3.51	0.03	0.02	0.07	0.05	33.03
Denver Basin ASR & Conduit M	155	30	2.50	649.5	60	6,040,350	93.66	6.93	0.17	0.06	7.16	0.07	0.03	0.14	0.11	67.37

Total Emissions (tons/year)										
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e	
14.502	1.073	0.026	0.009	1.109	0.010	0.005	0.022	0.017	10.432	
37.465	2.772	0.067	0.024	2.866	0.026	0.013	0.057	0.043	26.948	

Exhaust Emissions from Delivery Trucks

Emission Factors (g/mile) ³												
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
10.996	11.568	0.352	0.144	0.507	1.469	0.013	0.018	0.029	0.057	2.732	1.26E-04	0.005

Site	Truck Type	Trips per Day	Years	Hauling Days per Year	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)										
							CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
Gross Reservoir	Haul and Concrete Trucks	21	3.17	260	96	1,659,840	20.12	21.17	0.64	0.26	0.93	2.69	0.02	0.03	0.05	0.10	7.73

Total Emissions (tons/year)										
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
6.35	6.68	0.20	0.08	0.29	0.85	0.01	0.01	0.02	0.03	2.44

¹ Assumes 21.65 work days per month.

² Composite emission factors from APCD for 2007 (e-mail from Dale Wells, APCD 4/20/07).

³ Assumes average vehicle weight of 60,000 lbs and is based on emission factors from APCD for 2008 (e-mail from Dale Wells, APCD 5/22/07). Emission factors would decline over the life of the project.

⁴ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Source: Exhaust Emissions from Onroad Vehicles
Alternative: Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
Project: Moffat Collection System Project

Estimated Emissions from Construction Worker Vehicles (Personal)

Emission Factors (g/mile) ²											
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
14.067	1.041	0.025	0.009	1.076	0.010	0.005	0.022	0.016	1.096	8.15E-05	0.029

Site	Trips per Day	Months	Years	Total Work Days ¹	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)									
							CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e ⁴
Gross Reservoir	60	43	3.58	930.95	60	3,351,420	51.97	3.85	0.09	0.03	3.98	0.04	0.02	0.08	0.06	37.38
Gravel Pit Storage & Conduit O	89	30	2.50	649.5	60	3,468,330	53.78	3.98	0.10	0.03	4.11	0.04	0.02	0.08	0.06	38.68

Total Emissions (tons/year)									
CO	NO _x	PM ₁₀	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
14.502	1.073	0.026	0.009	1.109	0.010	0.005	0.022	0.017	10.432
21.512	1.592	0.038	0.014	1.645	0.015	0.008	0.033	0.025	15.474

Exhaust Emissions from Delivery Trucks

Emission Factors (g/mile) ³												
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂	CH ₄	N ₂ O
10.996	11.568	0.352	0.144	0.507	1.469	0.013	0.018	0.029	0.057	2.732	1.26E-04	0.005

Site	Truck Type	Trips per Day	Years	Hauling Days per Year	Average Distance (miles)	Total Vehicles Miles Traveled	Total Emissions (tons)										
							CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
Gross Reservoir	Haul and Concrete Trucks	21	3.58	260	96	1,878,240	22.77	23.95	0.73	0.30	1.05	3.04	0.03	0.04	0.06	0.12	8.74

Total Emissions (tons/year)										
CO	NO _x	PM ₁₀	PM _{2.5}	SO ₂	HC	1, 3 Butadiene	Acet-aldehyde	Benzene	Formaldehyde	CO ₂ e
6.35	6.68	0.20	0.08	0.29	0.85	0.01	0.01	0.02	0.03	2.44

¹ Assumes 21.65 work days per month.

² Composite emission factors from APCD for 2007 (e-mail from Dale Wells, APCD 4/20/07).

³ Assumes average vehicle weight of 60,000 lbs and is based on emission factors from APCD for 2008 (e-mail from Dale Wells, APCD 5/22/07). Emission factors would decline over the life of the project.

⁴ Global Warming Potential from 40 CFR Part 98, Subpart A, Table A-1. (CO₂ = 1; CH₄ = 21; N₂O = 310)

Rock Crushing/Screening

Source:
Alternative:
Project:

Rock Crushing/Screening
Proposed Action (Alternative 1a) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]
Moffat Collection System Project

Source	Years	Amount of rock (cy)	Rock density (ton/cy) ¹	Emission Factors (lb/ton) ²		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Tertiary crushing (uncontrolled)	3	426,600	1.391	0.0024	0.0000	0.712	0.000	0.237	0.000
Screening (uncontrolled)	3	426,600	1.391	0.0087	0.0000	2.581	0.000	0.860	0.000
Truck unloading (fragmented stone)	3	426,600	1.391	0.0000	0.0000	0.005	0.000	0.002	0.000
Truck unloading (conveyor, crushed stone)	3	426,600	1.391	0.0001	0.0000	0.030	0.000	0.010	0.000
Total Emissions (tons)						3.328	0.000	1.109	0.000

Source	Years	Amount of concrete (cy)	Concrete density (ton/cy) ³	Emission Factors (lb/ton) ⁴		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5} ⁵	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Concrete batching	3	853,200	2.012	0.0260	0.0260	22.351	22.351	7.450	7.450

1. Rock density is assumed to be 1,650 kg/m³. This is equivalent to 1.391 ton/cy.

2. Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources." EPA AP-42 Section 11.19.2, August 2004.

3. Concrete density is assumed to be 4,024 lbs/cy. EPA AP-42 Table 11.12-2 Footnote a.

4. Emission factors taken from EPA AP-42 Table 11.12-2, sum of controlled, total PM₁₀.

5. PM_{2.5} is assumed to be equivalent to PM₁₀.

Source:
Alternative:
Project:

Rock Crushing/Screening
Alternative 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Moffat Collection System Project

Source	Years	Amount of rock (cy)	Rock density (ton/cy) ¹	Emission Factors (lb/ton) ²		Total Emissions (tons)		Total Emissions (tons)	
				PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Tertiary crushing (uncontrolled)	3	250,200	1.391	0.0024	0.0000	0.418	0.000	0.139	0.000
Screening (uncontrolled)	3	250,200	1.391	0.0087	0.0000	1.514	0.000	0.505	0.000
Truck unloading (fragmented stone)	3	250,200	1.391	0.0000	0.0000	0.003	0.000	0.001	0.000
Truck unloading (conveyor, crushed stone)	3	250,200	1.391	0.0001	0.0000	0.017	0.000	0.006	0.000
				Total Emissions (tons)		1.952	0.000	0.651	0.000

Source	Years	Amount of concrete (cy)	Concrete density (ton/cy) ³	Emission Factors (lb/ton) ⁴		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5} ⁵	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Concrete batching	3	500,400	2.012	0.0260	0.0260	13.109	13.109	4.370	4.370

1. Rock density is assumed to be 1,650 kg/m3. This is equivalent to 1.391 ton/cy.

2. Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources." EPA AP-42 Section 11.19.2, August 2004.

3. Concrete density is assumed to be 4,024 lbs/cy. EPA AP-42 Table 11.12-2 Footnote a.

4. Emission factors taken from EPA AP-42 Table 11.12-2, sum of controlled, total PM₁₀.

5. PM_{2.5} is assumed to be equivalent to PM₁₀.

Source:
Alternative:
Project:

Rock Crushing/Screening
Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Moffat Collection System Project

Source	Years	Amount of rock (cy)	Rock density (ton/cy) ²	Emission Factors (lb/ton) ¹		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Tertiary crushing (uncontrolled)	3	312,600	1.391	0.0024	0.0000	0.522	0.000	0.174	0.000
Screening (uncontrolled)	3	312,600	1.391	0.0087	0.0000	1.891	0.000	0.630	0.000
Truck unloading (fragmented stone)	3	312,600	1.391	0.0000	0.0000	0.003	0.000	0.001	0.000
Truck unloading (conveyor, crushed stone)	3	312,600	1.391	0.0001	0.0000	0.022	0.000	0.007	0.000
				Total Emissions (tons)		2.439	0.000	0.813	0.000

Source	Years	Amount of concrete (cy)	Concrete density (ton/cy) ³	Emission Factors (lb/ton) ⁴		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5} ⁵	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Concrete batching	3	625,200	2.012	0.0260	0.0260	16.378	16.378	5.459	5.459

1. Rock density is assumed to be 1,650 kg/m3. This is equivalent to 1.391 ton/cy.
2. Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources." EPA AP-42 Section 11.19.2, August 2004.
3. Concrete density is assumed to be 4,024 lbs/cy. EPA AP-42 Table 11.12-2 Footnote a.
4. Emission factors taken from EPA AP-42 Table 11.12-2, sum of controlled, total PM₁₀.
5. PM_{2.5} is assumed to be equivalent to PM₁₀.

Source: Rock Crushing/Screening
Alternative: Alternative 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Project: Moffat Collection System Project

Source	Years	Amount of rock (cy)	Rock density (ton/cy) ¹	Emission Factors (lb/ton) ²		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Tertiary crushing (uncontrolled)	3	312,600	1.391	0.0024	0.0000	0.522	0.000	0.174	0.000
Screening (uncontrolled)	3	312,600	1.391	0.0087	0.0000	1.891	0.000	0.630	0.000
Truck unloading (fragmented stone)	3	312,600	1.391	0.0000	0.0000	0.003	0.000	0.001	0.000
Truck unloading (conveyor, crushed stone)	3	312,600	1.391	0.0001	0.0000	0.022	0.000	0.007	0.000
				Total Emissions (tons)		2.439	0.000	0.813	0.000

Source	Years	Amount of concrete (cy)	Concrete density (ton/cy) ³	Emission Factors (lb/ton) ⁴		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5} ⁵	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Concrete batching	3	625,200	2.012	0.0260	0.0260	16.378	16.378	5.459	5.459

1. Rock density is assumed to be 1,650 kg/m3. This is equivalent to 1.391 ton/cy.

2. Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources." EPA AP-42 Section 11.19.2, August 2004.

3. Concrete density is assumed to be 4,024 lbs/cy. EPA AP-42 Table 11.12-2 Footnote a.

4. Emission factors taken from EPA AP-42 Table 11.12-2, sum of controlled, total PM₁₀.

5. PM_{2.5} is assumed to be equivalent to PM₁₀.

Source: Rock Crushing/Screening
Alternative: Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
Project: Moffat Collection System Project

Source	Years	Amount of rock (cy)	Rock density (ton/cy) ¹	Emission Factors (lb/ton) ²		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Tertiary crushing (uncontrolled)	3	357,000	1.391	0.0024	0.0000	0.596	0.000	0.199	0.000
Screening (uncontrolled)	3	357,000	1.391	0.0087	0.0000	2.160	0.000	0.720	0.000
Truck unloading (fragmented stone)	3	357,000	1.391	0.0000	0.0000	0.004	0.000	0.001	0.000
Truck unloading (conveyor, crushed stone)	3	357,000	1.391	0.0001	0.0000	0.025	0.000	0.008	0.000
Total Emissions (tons)						2.785	0.000	0.928	0.000

Source	Years	Amount of concrete (cy)	Concrete density (ton/cy) ³	Emission Factors (lb/ton) ⁴		Total Emissions (tons)		Total Emissions (tons/year)	
				PM ₁₀	PM _{2.5} ⁵	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Concrete batching	3	714,000	2.012	0.0260	0.0260	18.704	18.704	6.235	6.235

1. Rock density is assumed to be 1,650 kg/m³. This is equivalent to 1.391 ton/cy.
2. Emission factors taken from "Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources." EPA AP-42 Section 11.19.2, August 2004.
3. Concrete density is assumed to be 4,024 lbs/cy. EPA AP-42 Table 11.12-2 Footnote a.
4. Emission factors taken from EPA AP-42 Table 11.12-2, sum of controlled, total PM₁₀.
5. PM_{2.5} is assumed to be equivalent to PM₁₀.

Fugitive Dust Emissions

Source: Fugitive Dust Emissions
 Alternative: Proposed Action (Alternative 1a) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]
 Project: Moffat Collection System Project

Wind Erosion From Stockpiles

Site	Source	Amount Disturbed per Day (m ³)	Working Days per Year	Years	Erosion Potential (g/m ³) ¹ per day	PM10 Multiplier ²	PM2.5 Multiplier ²	PM10 Emission Factor (g/m ³) per year	PM2.5 Emission Factor (g/m ³) per year	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	PM10 Emissions (tons)	PM2.5 Emissions (tons)
Gross Reservoir	Soil Surface Disturbance	400	260	4.08	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	3.22	0.48
Total Wind Erosion Emissions (ton)												3.22	0.48

Construction Traffic on Unpaved Roads

Site	Equipment	Dust Control Method	Avg. Vehicle Weight (ton) ³	Avg. Vehicle Speed (mph)	Silt Content (%) ⁴	Moisture Content (%) ⁵	Years	Equipment-Months	Miles/Day ⁶	Distance (mi) ⁷	PM10 Emission Factor (lb/VMT) ⁸	PM2.5 Emission Factor (lb/VMT) ⁸	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)
Gross Reservoir	Heavy-Duty Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	4.08	882	2	38,808	2.96	0.30	57.36	5.74	105.98	10.59	25.95	2.59
	Scrapers	Water	27	15.0	8.5	2.4	4.08	---	---	17,647	2.96	0.30	26.08	2.61				
	On-highway Trucks	Water	3	20.0	8.5	2.4	4.08	539	5	59,290	0.76	0.08	22.54	2.24				
Total Unpaved Road Traffic Emissions												105.98	10.59	25.95	2.59			

Construction Traffic on Paved Roads

Site	Equipment	Avg. Vehicle Weight (ton)	Silt Loading (g/m ³) ⁹	PM10 Fleet Emission Factor (lb/VMT) ¹⁰	PM2.5 Fleet Emission Factor (lb/VMT) ¹⁰	Years	Working Days per Year	Miles/Day	Distance (mi)	PM10 Emission Factor (lb/VMT) ¹¹	PM2.5 Emission Factor (lb/VMT) ¹¹	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)
Gross Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	4.08	260	3600	3,822,000	0.026	0.004	50.15	6.97	156.36	22.58	38.29	5.53
	Delivery Vehicles	7	4.4	0.00047	0.00036	4.08	260	2112	2,242,240	0.095	0.014	106.21	15.61				
Total Paved Road Traffic Emissions												156.36	22.58	38.29	5.53		

1. Calculated using Equation 3 from EPA AP-42 Section 13.2.5, November 2006. u*=1.35945 and ut*=1.02

2. Taken from EPA AP-42 Section 13.2.5-2, November 2006

3. Average weight of 54,000 lbs used for calculations.

4. AP-42 (EPA 2004), Table 13.2.2-1, "Typical Silt Content Values of Surface Material on Industrial and Rural Unpaved Roads."

5. AP-42 (EPA 2004), Table 11.9-3, "Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations."

6. Assumes total distance traveled by heavy equipment (excluding scrapers) is 2 miles per day. For On-highway trucks, the distance is assumed to be 5 miles per day. There are 22 working days per month.

7. Scraper distance is based on the volume of soil moved and a round-trip distance of 3 miles

8. AP-42 (EPA 2004), Section 13.2.2 "Unpaved Roads", equations 1a and 1b.

9. AP-42 (EPA 2006), Table 13.2.1-3 Worst Case

10. AP-42 (EPA 2006), Table 13.2.1-2

11. AP-42 (EPA 2006), Section 13.2.1.3 Equation 1.

Source: Fugitive Dust Emissions
Alternative: Alternative 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Project: Moffat Collection System Project

Wind Erosion From Stockpiles

Site	Source	Amount Disturbed per Day (m ³)	Working Days per Year	Years	Erosion Potential (g/m ³) per day	PM10 Multiplier ²	PM2.5 Multiplier ²	PM10 Emission Factor (g/m ³) per year	PM2.5 Emission Factor (g/m ³) per year	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	PM10 Emissions (tons)	PM2.5 Emissions (tons)	
Gross Reservoir	Soil Surface Disturbance	400	260	3.08	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	2.43	0.36	
Leyden Gulch Reservoir	Soil Surface Disturbance	400	260	3.50	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	2.76	0.41	
												Total Wind Erosion Emissions (ton)	5.19	0.78

Material Handling (Trenching)

Source	Years	Mean Wind Speed (m/s)	Moisture Content (%)	Trench Volume (cy)	Times Handled ³	Soil Density (tons/cy)	PM10 Emission Factor (lb/ton) ⁴	PM2.5 Emission Factor (lb/ton) ⁴	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)				
Leyden Gulch Outlet	3.5	8.646	3.4	250,500	2	1.053	0.0011	0.0002	0.29	0.04	0.08	0.01				
												Total Material Handling Emissions	0.29	0.04	0.08	0.01

Construction Traffic on Unpaved Roads

Site	Equipment	Dust Control Method	Avg. Vehicle Weight (ton) ⁵	Avg. Vehicle Speed (mph)	Silt Content (%) ⁶	Moisture Content (%) ⁷	Years	Equipment-Months	Miles/Day ⁸	Distance (mi) ⁹	PM10 Emission Factor (lb/VMT) ¹⁰	PM2.5 Emission Factor (lb/VMT) ¹⁰	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)
Gross Reservoir	Heavy-Duty Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	3.08	666	2	29,304	2.96	0.30	43.31	4.33	79.50	7.94	25.78	2.58
	Scrapers	Water	27	15.0	8.5	2.4	3.08	---	---	12,971	2.96	0.30	19.17	1.92				
Leyden Gulch Reservoir	Heavy-Duty Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	3.50	1008	2	44,352	2.96	0.30	65.55	6.56	1525.95	152.59	435.99	43.60
	Scrapers	Water	27	15.0	8.5	2.4	3.50	---	---	975,000	2.96	0.30	1441.08	144.11				
												Total Unpaved Road Traffic Emissions	1605.46	160.53	461.77	46.17		

Construction Traffic on Paved Roads

Site	Equipment	Avg. Vehicle Weight (ton)	Silt Loading (g/m ²) ¹¹	PM10 Fleet Emission Factor (lb/VMT) ¹²	PM2.5 Fleet Emission Factor (lb/VMT) ¹²	Years	Working Days per Year	Miles/Day	Distance (mi)	PM10 Emission Factor (lb/VMT) ¹³	PM2.5 Emission Factor (lb/VMT) ¹³	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	
Gross Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	3.08	260	3600	2,886,000	0.026	0.004	37.87	5.26	99.84	14.37	32.38	4.66	
	Delivery Vehicles	7	4.4	0.00047	0.00036	3.08	260	1632	1,308,320	0.095	0.014	61.97	9.11					
Leyden Gulch Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	3.50	260	7980	7,261,800	0.026	0.004	95.28	12.24	95.28	13.24	27.22	3.78	
												Total Paved Road Traffic Emissions	195.12	27.61	59.60	8.44		

1. Calculated using Equation 3 from EPA AP-42 Section 13.2.5, November 2006. u=1.35945 and ut=1.02

2. Taken from EPA AP-42 Section 13.2.5-2, November 2006

3. Once for excavation and once for filling.

4. Calculated using Equation 1 from EPA AP-42 Section 13.2.4.3, November 2006.

5. Average weight of 54,000 lbs used for calculations.

6. AP-42 (EPA 2004), Table 13.2.2-1, "Typical Silt Content Values of Surface Material on Industrial and Rural Unpaved Roads."

7. AP-42 (EPA 2004), Table 11.9-3, "Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations."

8. Assumes total distance traveled by heavy equipment (excluding scrapers) is 2 miles per day. For On-highway trucks, the distance is assumed to be 5 miles per day. There are 22 working days per month.

9. Scraper distance is based on the volume of soil moved and a round-trip distance of 3 miles

10. AP-42 (EPA 2004), Section 13.2.2 "Unpaved Roads", equations 1a and 1b.

11. AP-42 (EPA 2006), Table 13.2.1-3 Worst Case

12. AP-42 (EPA 2006), Table 13.2.1-2

13. AP-42 (EPA 2006), Section 13.2.1.3 Equation 1.

Source: Fugitive Dust Emissions
Alternative: Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
Project: Moffat Collection System Project

Wind Erosion From Stockpiles

Site	Source	Amount Disturbed per Day (m ³)	Working Days per Year	Years	Erosion Potential (g/m ³) ¹ per day	PM10 Multiplier ²	PM2.5 Multiplier ²	PM10 Emission Factor (g/m ³) per year	PM2.5 Emission Factor (g/m ³) per year	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	PM10 Emissions (tons)	PM2.5 Emissions (tons)
Gross Reservoir	Soil Surface Disturbance	400	260	3.17	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	2.50	0.37

Total Wind Erosion Emissions (ton) 2.50 0.37

Material Handling (Trenching)

Source	Years	Mean Wind Speed (m/s)	Moisture Content (%)	Trench Volume (cy)	Times Handled ³	Soil Density (tons/cy)	PM10 Emission Factor (lb/ton) ⁴	PM2.5 Emission Factor (lb/ton) ⁴	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)
South Platte River Diversion & Gravel Pit Storage Pipelines	2.5	8.646	3.4	135,700	2	1.053	0.0011	0.0002	0.16	0.02	2.67	0.40	1.07	0.16
Conduit O	2.5	8.646	3.4	2,199,993	2	1.053	0.0011	0.0002	2.52	0.38				

Total Material Handling Emissions 2.67 0.40 1.07 0.16

Construction Traffic on Unpaved Roads

Site	Equipment	Dust Control Method	Avg. Vehicle Weight (ton) ⁵	Avg. Vehicle Speed (mph)	Silt Content (%) ⁶	Moisture Content (%) ⁷	Years	Equipment-Months	Miles/Day ⁸	Distance (mi) ⁹	PM10 Emission Factor (lb/VMT) ¹⁰	PM2.5 Emission Factor (lb/VMT) ¹⁰	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)		
Gross Reservoir	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	3.17	684	2	30,096	2.96	0.30	44.48	4.45			84.78	8.47	26.77	2.68
	Scrapers	Water	27	15.0	8.5	2.4	3.17	---	---	15,441	2.96	0.30	22.82	2.28						
	Trucks	Water	3	20.0	8.5	2.4	3.17	418	5	45,980	0.76	0.08	17.48	1.74						
South Platte River Diversion & Gravel Pit Storage	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	2.50	150	2	6,600	2.96	0.30	9.76	0.98			33.72	3.37	13.49	1.35
	Scrapers	Water	27	15.0	8.5	2.4	2.50	---	---	11,973	2.96	0.30	17.70	1.77						
	Trucks	Water	3	20.0	8.5	2.4	2.50	150	5	16,500	0.76	0.08	6.27	0.62						
Conduit O	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	2.50	150	2	6,600	2.96	0.30	9.76	0.98			302.94	30.29	121.18	12.12
	Scrapers	Water	27	15.0	8.5	2.4	2.50	---	---	194,117	2.96	0.30	286.91	28.69						
	Trucks	Water	3	20.0	8.5	2.4	2.50	150	5	16,500	0.76	0.08	6.27	0.62						

Total Unpaved Road Traffic Emissions 421.45 42.13 161.44 16.14

Construction Traffic on Paved Roads

Site	Equipment	Avg. Vehicle Weight (ton)	Silt Loading (g/m ³) ¹¹	PM10 Fleet Emission Factor (lb/VMT) ¹²	PM2.5 Fleet Emission Factor (lb/VMT) ¹²	Years	Working Days per Year	Miles/Day	Distance (mi)	PM10 Emission Factor (lb/VMT) ¹³	PM2.5 Emission Factor (lb/VMT) ¹³	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)		
Gross Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	3.17	260	3600	2,964,000	0.026	0.004	38.89	5.40			117.51	16.96	37.11	5.36
	Delivery Vehicles	7	4.4	0.00047	0.00036	3.17	260	2016	1,659,840	0.095	0.014	78.62	11.55						
South Platte River Diversion, Gravel Pit Storage & Conduit O	Commuter Traffic	3	4.4	0.00047	0.00036	2.50	260	6180	4,017,000	0.026	0.004	52.71	7.32	52.71	7.32	21.08	2.93		

Total Paved Road Traffic Emissions 170.22 24.28 58.19 8.28

1. Calculated using Equation 3 from EPA AP-42 Section 13.2.5, November 2006. u=1.35945 and ut=1.02

2. Taken from EPA AP-42 Section 13.2.5-2, November 2006

3. Once for excavation and once for filling.

4. Calculated using Equation 1 from EPA AP-42 Section 13.2.4.3, November 2006.

5. Average weight of 54,000 lbs used for calculations.

6. AP-42 (EPA 2004), Table 13.2.2-1, "Typical Silt Content Values of Surface Material on Industrial and Rural Unpaved Roads."

7. AP-42 (EPA 2004), Table 11.9-3, "Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations."

8. Assumes total distance traveled by heavy equipment (excluding scrapers) is 2 miles per day. For on-highway trucks, the distance is assumed to be 5 miles per day. There are 22 working days per month.

9. Scraper distance is based on the volume of soil moved and a round-trip distance of 3 miles

10. AP-42 (EPA 2004), Section 13.2.2.2 "Unpaved Roads", equations 1a and 1b.

11. AP-42 (EPA 2006), Table 13.2.1-3 Worst Case

12. AP-42 (EPA 2006), Table 13.2.1-2

13. AP-42 (EPA 2006), Section 13.2.1.3 Equation 1.

Source: Fugitive Dust Emissions
Alternative: Alternative 10a—Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Project: Moffat Collection System Project

Wind Erosion From Stockpiles

Site	Source	Amount Disturbed per Day (m ³)	Working Days per Year	Years	Erosion Potential (g/m ³) per day	PM10 Multiplier ²	PM2.5 Multiplier ²	PM10 Emission Factor (g/m ³) per year	PM2.5 Emission Factor (g/m ³) per year	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	PM10 Emissions (tons)	PM2.5 Emissions (tons)
Gross Reservoir	Soil Surface Disturbance	400	260	3.17	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	2.50	0.37
Total Wind Erosion Emissions (ton)												2.50	0.37

Material Handling (Trenching)

Source	Years	Mean Wind Speed (m/s)	Moisture Content (%)	Trench Volume (cy)	Times Handled ³	Soil Density (tons/cy)	PM10 Emission Factor (lb/ton) ⁴	PM2.5 Emission Factor (lb/ton) ⁴	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)	
Denver Basin ASR Pipeline	2.5	8.646	3.4	3,167,990	2	1.053	0.0011	0.0002	3.62	0.55	5.48	0.83	2.19	0.33	
Conduit M	2.5	8.646	3.4	1,827,995	2	1.053	0.0011	0.0002	1.86	0.28					
Total Material Handling Emissions												5.48	0.83	2.19	0.33

Construction Traffic on Unpaved Roads

Site	Equipment	Dust Control Method	Avg. Vehicle Weight (ton) ⁵	Avg. Vehicle Speed (mph)	Silt Content (%) ⁶	Moisture Content (%) ⁷	Years	Equipment-Months	Miles/Day ⁸	Distance (mi) ⁹	PM10 Emission Factor (lb/VMT) ¹⁰	PM2.5 Emission Factor (lb/VMT) ¹⁰	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)		
Gross Reservoir	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4		684	2	30,096	2.96	0.30	44.48	4.45			84.78	8.47	26.77	2.68
	Scrapers	Water	27	15.0	8.5	2.4	3.17	---	---	15,441	2.96	0.30	22.82	2.28						
	Trucks	Water	3	20.0	8.5	2.4	3.17	418	5	45,980	0.76	0.08	17.48	1.74						
Denver Basin ASR Pipeline	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	2.50	210	2	9,240	2.96	0.30	13.66	1.37			435.59	43.56	174.24	17.42
	Scrapers	Water	27	15.0	8.5	2.4	2.50	---	---	279,529	2.96	0.30	413.15	41.32						
	Trucks	Water	3	20.0	8.5	2.4	2.50	210	5	23,100	0.76	0.08	8.78	0.87						
Conduit M	Construction Equipment Except Scrapers	Water	27	15.0	8.5	2.4	2.50	150	2	6,600	2.96	0.30	9.76	0.98			228.34	22.83	91.34	9.13
	Scrapers	Water	27	15.0	8.5	2.4	2.50	---	---	143,647	2.96	0.30	210.31	21.03						
	Trucks	Water	3	20.0	8.5	2.4	2.50	150	5	16,500	0.76	0.08	6.27	0.62						
Total Unpaved Road Traffic Emissions												748.72	74.86	292.35	29.23					

Construction Traffic on Paved Roads

Site	Equipment	Avg. Vehicle Weight (ton)	Silt Loading (g/m ³) ¹¹	PM10 Fleet Emission Factor (lb/VMT) ¹²	PM2.5 Fleet Emission Factor (lb/VMT) ¹²	Years	Working Days per Year	Miles/Day	Distance (mi)	PM10 Emission Factor (lb/VMT) ¹³	PM2.5 Emission Factor (lb/VMT) ¹³	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (tons/year)	PM2.5 Emissions (tons/year)
Gross Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	3.17	260	3600	2,964,000	0.026	0.004	38.89	5.40	117.51	16.96	37.11	5.36
	Delivery Vehicles	7	4.4	0.00047	0.00036	3.17	260	2016	1,659,840	0.095	0.014	78.62	11.55				
Denver Basin ASR Pipeline & Conduit M	Commuter Traffic	3	4.4	0.00047	0.00036	2.50	260	9300	6,045,000	0.026	0.004	79.31	11.02	79.31	11.02	31.73	4.41
	Delivery Vehicles	7	4.4	0.00047	0.00036	2.50	260	2016	1,659,840	0.095	0.014	78.62	11.55				
Total Paved Road Traffic Emissions												196.83	27.98	68.83	9.76		

1. Calculated using Equation 3 from EPA AP-42 Section 13.2.5, November 2006. u'=1.35945 and ut'=1.02

2. Taken from EPA AP-42 Section 13.2.5-2, November 2006

3. Once for excavation and once for filling.

4. Calculated using a weight of 54,000 kg/ton for calculation.

5. AP-42 (EPA 2004), Table 13.2.2-1, "Typical Silt Content Values of Surface Material on Industrial and Rural Unpaved Roads."

6. AP-42 (EPA 2004), Table 11.9-3, "Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations."

7. Assumes total distance travelled by heavy equipment (excluding scrapers) is 2 miles per day. For On-highway trucks, the distance is assumed to be 5 miles per day. There are 22 working days per month.

8. Scraper distance is based on the volume of soil moved and a round-trip distance of 3 miles.

9. AP-42 (EPA 2004), Section 13.2.2 "Unpaved Roads", equations 1a and 1b.

10. AP-42 (EPA 2004), Table 13.2.2-1 "Unpaved Roads".

11. AP-42 (EPA 2006), Table 13.2.1-3 Worst Case

12. AP-42 (EPA 2006), Table 13.2.1-2

13. AP-42 (EPA 2006), Section 13.2.1.3 Equation 1.

Source: Fugitive Dust Emissions
Alternative: Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
Project: Moffat Collection System Project

Wind Erosion From Stockpiles

Site	Source	Amount Disturbed per Day (m ²)	Working Days per Year	Years	Erosion Potential (g/m ²) per day	PM10 Multiplier ²	PM2.5 Multiplier ²	PM10 Emission Factor (g/m ²) per year	PM2.5 Emission Factor (g/m ²) per year	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)	PM10 Emissions (tons)	PM2.5 Emissions (tons)
Gross Reservoir	Soil Surface Disturbance	400	260	3.58	15.2	0.5	0.075	1972.02	295.80	0.79	0.12	2.83	0.42
Total Wind Erosion Emissions (ton)												2.83	0.42

Material Handling (Trenching)

Source	Years	Mean Wind Speed (m/s)	Moisture Content (%)	Trench Volume (cy)	Times Handled ³	Soil Density	PM10 Emission Factor (lb/ton) ⁴	PM2.5 Emission Factor (lb/ton) ⁴	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (tons)	PM2.5 Emissions (tons)	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)	
South Platte River Division & Gravel Pit Storage Pipelines	2.5	8.646	3.4	452,499	2	1.053	0.0011	0.0002	0.52	0.08	3.03	0.46	1.21	0.18	
Conduit O	2.5	8.646	3.4	2,199,993	2	1.053	0.0011	0.0002	2.52	0.38					
Total Material Handling Emissions												3.03	0.46	1.21	0.18

Construction Traffic on Unpaved Roads

Site	Equipment	Dust Control Method	Avg. Vehicle Weight (ton) ⁵	Avg. Vehicle Speed (mph)	Silt Content (%) ⁶	Moisture Content (%) ⁷	Years	Equipment-Months	Miles/Day ⁸	Distance (mi) ⁹	PM10 Emission Factor (lb/VMT) ¹⁰	PM2.5 Emission Factor (lb/VMT) ¹⁰	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)		
Gross Reservoir	Construction Equipment Except Scrapers																			
	Water	27	15.0	8.5	2.4	3.58	774	2	34,056	2.96	0.30	50.34	5.03			94.44	9.44	26.35	2.63	
	Scrapers	Water	27	15.0	8.5	2.4	3.58	---	16,456	2.96	0.30	24.32	2.43							
South Platte River Division & Gravel Pit Storage Pipeline	Trucks	Water	3	20.0	8.5	2.4	3.58	473	5	52,030	0.76	0.08	19.78	1.97						
	Construction Equipment Except Scrapers																75.04	7.50	30.02	3.00
	Scrapers	Water	27	15.0	8.5	2.4	2.50	150	2	6,600	2.96	0.30	9.76	0.98						
Conduit O	Trucks	Water	3	20.0	8.5	2.4	2.50	150	5	16,500	0.76	0.08	6.27	0.62						
	Construction Equipment Except Scrapers																302.94	30.29	121.18	12.12
	Scrapers	Water	27	15.0	8.5	2.4	2.50	150	2	6,600	2.96	0.30	9.76	0.98						
	Trucks	Water	3	20.0	8.5	2.4	2.50	150	5	16,500	0.76	0.08	6.27	0.62						
Total Unpaved Road Traffic Emissions												472.41	47.23	177.55	17.75					

Construction Traffic on Paved Roads

Site	Equipment	Avg. Vehicle Weight (ton)	Silt Loading (g/m ²) ¹¹	PM10 Fleet Emission Factor (lb/VMT) ¹²	PM2.5 Fleet Emission Factor (lb/VMT) ¹²	Years	Working Days per Year	Miles/Day	Distance (mi)	PM10 Emission Factor (lb/VMT) ¹³	PM2.5 Emission Factor (lb/VMT) ¹³	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton)	PM2.5 Emissions (ton)	PM10 Emissions (ton/year)	PM2.5 Emissions (ton/year)
Gross Reservoir	Commuter Traffic	3	4.4	0.00047	0.00036	3.58	260	3600	3,354,000	0.026	0.004	44.01	6.12	132.97	19.19	37.11	5.36
	Delivery Vehicles	7	4.4	0.00047	0.00036	3.58	260	2016	1,878,240	0.095	0.014	88.97	13.07				
South Platte River Division, Gravel Pit Storage & Conduit O	Commuter Traffic	3	4.4	0.00047	0.00036	2.50	260	5340	3,471,000	0.026	0.004	45.54	6.33	45.54	6.33	18.22	2.53
Total Paved Road Traffic Emissions												178.52	25.52	55.33	7.89		

1. Calculated using Equation 3 from EPA AP-42 Section 13.2.5, November 2006. $u=1.35945$ and $u_i=1.02$

2. Taken from EPA AP-42 Section 13.2.5-2, November 2006

3. Once for excavation and once for forming.

4. Calculated using Equation 1 from EPA AP-42 Section 13.2.4.3, November 2006.

5. Average weight of 54,000 lbs used for calculation.

6. AP-42 (EPA 2004), Table 13.2.2-1, "Typical Silt Content Values of Surface Material on Industrial and Rural Unpaved Roads."

7. AP-42 (EPA 2004), Table 11.9-3, "Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations."

8. Assumes total distance travelled by heavy equipment (excluding scrapers) is 2 miles per day. For On-highway trucks, the distance is assumed to be 5 miles per day. There are 22 working days per month.

9. Scraper distance is based on the volume of soil moved and a round-trip distance of 3 miles

10. AP-42 (EPA 2004), Section 13.2.2 "Unpaved Roads", equations 1a and 1b.

11. AP-42 (EPA 2006), Table 13.2.1-3 Worst Case

12. AP-42 (EPA 2006), Table 13.2.1-2

13. AP-42 (EPA 2006), Section 13.2.1.3 Equation 1.

Additional Data

Data: **Proposed Action (Alternative 1a) Additional Data**
Alternative: **Proposed Action (Alternative 1a) — Enlarged Gross Reservoir with Environmental Pool for Mitigation [Additional 77,000 AF]**
Project: **Moffat Collection System Project**

Construction Disturbance	Acres
Gross Reservoir	183.8
Total Area Disturbed	183.8

Gross Reservoir - Roads

Type	Length (ft)	Width (ft)
Access Roads	5,605	30
Haul Roads	3,050	50

Access road length is 2,300 ft for permanent spillway road, 1,500 ft for each permanent dam access roads, and 305 ft for temporary spillway road.

Gross Reservoir - Volume of Dirt Moved for Dam

Volume Moved:	200,000 yd³
---------------	-------------------------------

Volume of Rock Crushed

Volume Crushed:	426,600 yd³
-----------------	-------------------------------

Volume of Concrete Produced

Volume Produced:	853,200 yd³
------------------	-------------------------------

Notes:

Concrete placement would occur during May through September for three years.

Data: Alternative 1c Additional Data
Alternative: Alternative 1c — Enlarged Gross Reservoir and New Leyden Gulch Reservoir
Project: Moffat Collection System Project

Construction Disturbance	Acres
Gross Reservoir	186.1
Leyden Gulch Reservoir	203.3
Total Area Disturbed	389.4

Gross Reservoir - Roads

Type	Length (ft)	Width (ft)	
Access Roads	5,605	30	Access road length is 2,300 ft for permanent spillway
Haul Roads	3,050	50	road, 1,500 ft for both permanent dam access roads (combined), and 305 ft for temporary spillway road.

Gross Reservoir - Volume of Dirt Moved for Dam

Volume Moved:	147,000 yd ³
---------------	-------------------------

Volume of Rock Crushed

Volume Crushed:	250,200 yd ³
-----------------	-------------------------

Volume of Concrete Produced

Volume Produced:	500,400 yd ³
------------------	-------------------------

Roads - New Leyden Gulch Reservoir

Type	Length (ft)	Width (ft)	
Access Roads	8,363	50	9.6 acres is 418,176 ft ² .
Highway 93	4,000	77	

Volume of Dirt Moved for Leyden Gulch Dam

Embankment Zone 1	5,500,000 yd ³
Embankment Zone 2	4,800,000 yd ³
Embankment Zone 3	750,000 yd ³
Volume Moved:	11,050,000 yd ³

Leyden Gulch Outlet

	Length (ft)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	9750	30	15	162500.00

Canal Redirection

	Length (ft)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	5279.98944	30	15	87999.82

Data: Alternative 8a Additional Data
 Alternative: Alternative 8a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage
 Project: Moffat Collection System Project

Construction Disturbance	Acres
Gross Reservoir	184.8
South Platte Facilities	14.2
Total Area Disturbed	199.0

Gross Reservoir - Roads

Type	Length (ft)	Width (ft)	
Access Roads	5,605	30	for each permanent dam access roads, and 305 ft for temporary
Haul Roads	3,050	50	spillway road.

Gross Reservoir - Volume of Dirt Moved for Dam

Volume Moved:	175,000	yd ³
---------------	---------	-----------------

Volume of Rock Crushed

Volume Crushed:	312,600	yd ³
-----------------	---------	-----------------

Volume of Concrete Produced

Volume Produced:	625,200	yd ³
------------------	---------	-----------------

South Platte River Diversion - Pipeline

	Length (ft)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	750	30	15	12499.99

Gravel Pit Storage - Pipeline

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	1.4	30	15	123199.63

Conduit O

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	25	30	15	2199993.40

Data: Alternative 10a Additional Data
Alternative: Alternative 10a — Enlarged Gross Reservoir and Reusable Effluent Stored in Denver Basin Injection/Recovery Wells
Project: Moffat Collection System Project

Construction Disturbance	Acres
Gross Reservoir	184.8
Denver Basin ASR	34.0
Total Area Disturbed	218.8

Gross Reservoir - Roads

Type	Length (ft)	Width (ft)	
Access Roads	5,605	30	for both permanent dam access roads (combined), and 305 ft for
Haul Roads	3,050	50	temporary spillway road.

Gross Reservoir - Volume of Dirt Moved for Dam

Volume Moved:	175,000	yd ³
---------------	---------	-----------------

Volume of Rock Crushed

Volume Crushed:	312,600	yd ³
-----------------	---------	-----------------

Volume of Concrete Produced

Volume Produced:	625,200	yd ³
------------------	---------	-----------------

Conduit - Denver Basin ASR

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	36	30	15	3167990.50

Length is based on length of temporary disturbance.

Conduit M

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	18.5	30	15	1627995.12

Length is based on length of temporary disturbance.

Data: Alternative 13a Additional Data
Alternative: Alternative 13a — Enlarged Gross Reservoir and Reusable South Platte River Return Flow in Gravel Pit Storage plus Agricultural Water Rights Transfers
Project: Moffat Collection System Project

Construction Disturbance	Acres
Gross Reservoir	184.3
South Platte Facilities	14.2
Total Area Disturbed	198.5

Gross Reservoir - Roads

Type	Length (ft)	Width (ft)	
Access Roads	5,605	30	Access road length is 2,300 ft for permanent spillway road, 1,500 ft for each permanent dam access roads, and 305 ft for
Haul Roads	3,050	50	temporary spillway road.

Gross Reservoir - Volume of Dirt Moved for Dam

Volume Moved:	186,500	yd ³
---------------	---------	-----------------

Volume of Rock Crushed

Volume Crushed:	357,000	yd ³
-----------------	---------	-----------------

Volume of Concrete Produced

Volume Produced:	714,000	yd ³
------------------	---------	-----------------

South Platte River Diversion - Pipeline

	Length (ft)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	750	30	15	12499.99

Gravel Pit Storage - Pipeline

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	5	30	15	439998.68

Conduit O

	Length (mi)	Width (ft)	Depth (ft)	Volume (cy)
Trench Size:	25	30	15	2199993.40

Length is based on length of temporary disturbance.

Alt. 13a Data

